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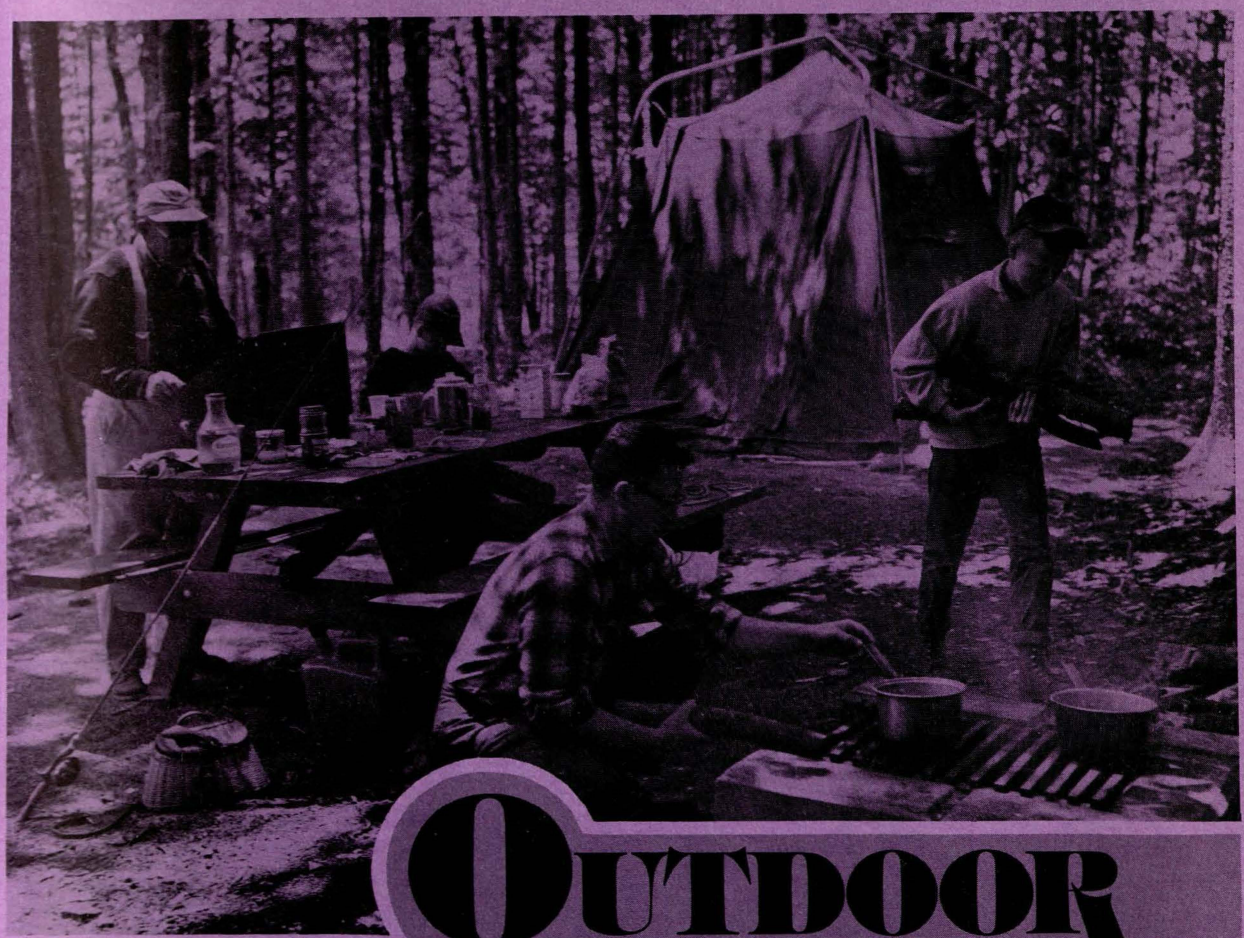

OUTDOOR RECREATION RESEARCH: APPLYING the RESULTS

PAPERS FROM A WORKSHOP HELD BY THE USDA FOREST SERVICE AT MARQUETTE, MICHIGAN, JUNE 19-21, 1973.

NORTH CENTRAL FOREST EXPERIMENT STATION
FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

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FOREWORD

These collected papers were the basis for discussions at a Recreation Research Applications Workshop held at Marquette, Michigan, in June 1973. The Workshop was designed to bring together Forest Service recreation researchers from throughout the country and forest recreation planners and managers from the north-central States for the purpose of exchanging information, ideas, and problems, and encouraging the application of research findings by practitioners.

A key part of the Workshop was of course the discussion among the 80 some persons who attended. But the papers themselves, state-of-the-science summaries prepared in advance by experts in various fields, contain valuable information worthy of much wider dissemination.

Recreation research is rather new for Forest Service scientists and for their colleagues in other public and private organizations. There is a need for all researchers to work closely with land managers. The Marquette Workshop was one effort to promote this interaction. We hope these papers will be useful to the many interested people who could not attend.

popularity. The length of the trail desired varies as to his purpose. The backpacker is more or less self-contained, carrying his own food and equipment. The length of trail required for a backpacker should be considerably longer than for the day hiker. The backpacker requires a place to camp. If backpackers pick the same campsite continuously, there is a sanitation problem. Sanitation facilities in remote areas are expensive to build and difficult to maintain. Backpackers are best characterized by their desire to get away from the sound and the rush of the daily world. Most man-made sounds are objectionable to them. The hiker and the backpacker require space, much as the horseback rider and the motorcyclist. The hiker's and backpacker's need for esthetic surroundings is high.

River floaters who prefer the non-motorized experience of a canoe or johnboat desire solitude and quiet, though they are also gregarious and prefer to make trips in groups. Most floaters don't seem to object to groups of their own kind. However, they resent groups of other kinds, including hikers. Floaters can present sanitation problems, particularly if they camp overnight.

Substantial Federal ownership or esthetic control is desirable along good float streams. Ownership currently presents a more serious problem for floaters than for the backpacker or the cyclist because most riverbanks are in private ownership which hinders access to streams and leads to unesthetic development on their margins.

The floater is also in conflict with the bank fisherman or the boat fisherman or the motorboater.

The use of motors on rivers has several adverse effects: the noise, wave action eroding the bank, the oil film left on the water, the safety hazard to other boats, and bank fishermen being disturbed by the motorboat.

Fishermen fall primarily into two groups, boat fishermen and bank fishermen. The boat fisherman often has the same impact as the powerboater. Fishermen generally prefer their section of the river to be their own so they have less competition. They generally resent intrusion by other users. The biggest problem presented by boat fishermen is the litter left in the streams. Bank fishermen create other problems, though normally they are confined to areas near where they can park their cars. They create trails along the stream, wear down the bank at places where they fish, and are responsible for most of the bank's litter. Most bank fishermen resent boats crossing their lines or otherwise disturbing their immediate fishing area. Most fishermen, whether bank or boat fishing, prefer access close to where the fishing is. The use of automobiles in stream bottoms is always a risky proposition. The roads they create are susceptible to erosion damage during times of floods. Auto access also means that more litter can be carried in.

The water skier requires large acreages of water in which to ski. The only area on the Mark Twain available for this is Table Rock Lake. He causes no problem to other water users until he approaches the bank. Then he interferes with the fishermen along the bank. The noise of the ski boat is often distracting to other users. The ski boat by its size requires a launching lane into the water. The ramp and the associated parking lot can take up a substantial area.

Swimmers look for clear, clean water in a safe environment. They do not want to be threatened by ski boats, other motorboats or fishermen. Oil from two-cycle engines leaves an unpleasant film on the water. Swimmers normally prefer to park close to the swimming area. They want a clean environment to change clothes. They need a safe, clean walk from the parking lot or bathhouse to the beach. The swimming area should be carefully graded and marked with buoys. The construction of a bathhouse near the water always presents waste disposal problems.

Hunting, by the nature of the sport, requires a substantial area. Many hunters seem to want to drive into the location where they are going to hunt, yet have the area to themselves. The hunter does not normally care to hunt in areas where other people are. This scares his game and reduces his chance of a kill. Nothing would irritate a hunter more than to have a deer in his rifle sights and have the animal scared off by a motorcyclist or other user.

Hikers and others avoid woods during big game season out of fear of being shot. On extended squirrel, deer, or turkey hunting trips, hunters will often set up a camp. Where hunting camps have been established through the years, trees have been cut for firewood, and camp furniture, tent poles, and litter remain. Hunters sometimes cause forest fires by setting fires in den trees to smoke out squirrels.

Most people who go to the forest to observe wildlife seek a degree of quiet and solitude. Any other interference is an intrusion on their activity. It is hard to accommodate these people specifically, unless there are placed like heron rookeries, beaver dams, or other predictable habitations.

People who drive or ride for pleasure are concerned primarily with the beauty of the forest and the road on which they are riding. The pleasure driver would prefer to be on a road with little traffic, low speed, and preferably without many obstructions. The pleasure rider would prefer not to see many of the harsh practices involved in forest land management.

Picnickers usually seek a pleasant spot in which to have their lunch. This does not necessarily have to be a developed site. They would prefer to drive close to the place where they will eat. Three hundred feet is about the maximum distance anyone will carry a picnic basket. They prefer a table, a fireplace or charcoal grill in the shade. They desire shelters during inclement weather. Some of the problems involved are sanitation, littering, and auto access. Drinking water is desirable. Open areas for games such as horsehoes and softball are desirable.

Auto camper desires vary from isolation to crowds; from primitive to motel-type accommodations. Equipment varies from the primitive essentials to self-contained units. Auto campers need a place to park and sanitation. In a National Forest this means roads for access, a spur on which to park, tent space, a garbage receptacle, and toilet. Drinking water is optional. Roads, spurs, and spacing require room. Sanitation becomes more complex as size increases. Pollution standards become tighter as proximity to water increases. Auto campsites are more costly and complex to maintain and rehabilitate. Self-contained units are causing problems such as dumping holding tanks and draining sinks. Transistorized radio-TV's are noise polluters. In addition, campers want activities such as fishing, swimming or hiking near the campground.

"Pot hunter" is the term used to describe people who comb the National Forests for historical and prehistorical artifacts for fun and profit. This is an illegal act that is difficult to control. This type of collector is particularly harmful because he destroys knowledge as well as beauty or material value.

Vandalism, a common but unappreciated use, takes many forms. It ranges from tearing down notices on a bulletin board to burning down a building. These acts are encouraged by isolated sites and sparse administration which creates the opportunity to vandalize unobserved. Vandalism is usually the result of, or the aftermath of, a late night party when judgments are impaired by alcohol or drugs. Vandalism extends beyond the developed sites to include the wanton destruction of caves or other natural features.

OUR DILEMMA

Historically, we have looked to development as a means of accommodating forest users. By concentrating on development, we have, in the past, alienated most people seeking dispersed recreation. These people came to the forest anyway. When their numbers increased to where an impact or conflict was being felt, the forest was not prepared, through staffing, attitudes, and policies, to cope with the situation. Conversely, we have seldom tied developed sites in with good dispersed-use opportunities as skillfully as we could. Thus we found ourselves with developed, but unused sites, because once there the camper had nothing to do.

Legislation, national policies, and recognition of trends have brought about change. The gap between wilderness and auto campgrounds is wide, diverse, and competitive. This competition is best displayed through the current forms of legislation proposed to designate land for one purpose or another.

The Forest Service has found its vast acreages shrinking rapidly. The unit of measure is in the mind. What was once thought of as timber producing or grazing land is now being considered for many other purposes. The many publics and interests want their fair share.

Today's manager often finds that he must be the judge of what a fair share is on his land unit. This judgment is often made with insufficient evidence.

There are no hard answers to most management allocation problems. Just as there are several options within the recreation function, there are many more options in other functions--all for the same acre of land. There are decisions made daily which may affect a piece of landscape for a century. A manager must know what areas to dedicate to long-term use without sacrificing too many options. There are various methods of collecting, storing, and processing data. There are also various methods of using data to arrive at decisions. None of the methods will yield a perfect answer because there is none.

It is in vogue to speak of mixes. What is the right management mix? Again, there is no perfect mix. A plan decided on today is obsolete tomorrow. The changes are brought about by competition for the land to yield different goods and services. There is also a strong competition for the time of forest personnel. Land use allocations are affected strongly by assignment of personnel. The most competitive people will present the stronger case. This must be recognized as a part of land management.

THE LITERATURE

Available recreation research literature for the last 10 years was reviewed for this project. It was screened for content as it applied to land use allocations. There are studies which apply to parts of demand, user preferences, and methods of recreation land allocations. Most studies, by necessity, are based on strict geographic limits.

This presents a problem in managing National Forests in the Ozark Region. User preferences, habits, and use patterns vary considerably on Districts within the Mark Twain National Forest. These differences should be reflected throughout National Forests and Districts in the Ozark Region. In the final analysis, the managers and planners must rely on past use trends, inventories, projections, and judgment to allocate land for specific uses. We can find no research conducted in the Ozark Region for any form of recreation use. We conclude that research is needed on a regional basis to provide more applicable guides to administration.

Management Allocations in Practice

We've coped, and are coping, with a few allocation problems on the Mark Twain and thought we would share them with you.

Demand figures, which directly affect planning and allocation, have been inadequate. There is hope on the horizon from current studies that will improve this situation. There is a general problem in many demand data.

For example, the State Recreation Plan for Missouri draws general conclusions which are not applicable to National Forest use. The category "camping" ranges from highly developed organization camps to undeveloped sites. The National forests meet a small portion of this demand and then only that of those campers interested in a specific type of environment.

On Table Rock Lake there are family campgrounds provided by private enterprise, the State of Missouri, the Corps of Engineers, and the Forest Service. All have different philosophies of management, design, and construction. All are experiencing a capacity use by people seeking the experience level they prefer. Statistically, these sites are lumped under the general category of camping, yet there are in reality five different activities. Saturation of one category could negate construction of another type of campground which is badly needed. Data by use category must be expanded before it is realistic.

We are currently constructing hiking trails in response to an apparent demand by conservation clubs, scouts, and individuals. These trails are being used, but it is too early to say if they will be used enough to be called successful.

The Chadwick area of the Ava District has a long established use of several hundred motorcycle riders per weekend during cool weather. The riders had established a trail system of sorts and several hill climbs. Erosion was becoming severe. Riders were turning to other places on the forest, endangering more fragile landscapes. The forest is attempting to control this use by: (1) constructing a 50-mile trail system to Forest Service standards, (2) initiating rules and regulations to prohibit off-trial use, (3) closing the remainder of the forest to off-road use by motorized vehicles.

Motorboating on small lakes, under 50 acres, is not allowed on the Mark Twain because of the lack of space, water pollution, noise and bank erosion. A substantial boat landing is needed to launch a motorboat, more so than for carry-in nonpower craft.

The majority of lands within the Eleven Point National Scenic River are zoned for experience level two. We have planned two activities within the zone which are within this experience level. The zone will be accessible by nonpower boat and by foot. Float camps are generally separated from hiking camps. Hikers using float camps during the floating season could exceed the carrying capacity of the campsite. Through trail layout, design and information, we will discourage hikers from using most float camps. Although the seasons for hiking and floating are different, each is extending, and overlap is likely. The peak use for boating occurs during the hot summer months. For hiking it is spring and fall. Until spring and fall floating use becomes heavier, the float camps could accommodate some hikers.

The use of motors on johnboats on the Eleven Point River is being discouraged and may eventually be restricted by regulation. An exception to this is being made to accommodate the gigger during the fall gigging season. This sport is traditionally conducted at night with lights and occurs in late fall. Allocation in this activity is within a time frame.

Seasons and time of day have a direct relationship in allocating activity opportunities. A classic example is the use of motorcycles and nature study. In Missouri, summer temperatures are too high for the air-cooled trail bikes. The trails vacated by motorcycles during the summer months could be used by nature hikers. This allows activities that would normally be in conflict to occur on the same area.

A campground was constructed adjacent to U.S. 60, a major east-west arterial carrying up to 5,000 cars daily. Highway traffic studies indicated 10 percent plus was cross-country vacation traffic. After 3 years of operation, the primary use of this site occurs late in the evening after a local drive-in movie closes. Legitimate campers would account for less than 5 percent of the total use. The site was probably developed before sufficient study was completed.

A well-planned study does not always have the final answer. A ranger on the Van Buren District sent an inquiry to most of the listed saddle clubs in the State of Missouri. The response favorable to a cross-country trail was overwhelming. On the strength of this response, 15 miles of horse trail, a corral-picnic ground, and two ponds were constructed. A brochure was prepared to inform trail riders of these facilities. Over an 8-year period, actual use has been confined to one annual organized trail ride and sporadic small group use. We had a very similar experience within 40 miles of Springfield where there are over 3,000 horses stabled. In the Springfield case, the public demanded, the Forest Service responded, but the use did not materialize.

Carman Springs is a cooperative game refuge with the State of Missouri on the National Forest. The original purpose of stocking game animals and birds has about lost its significance. Should the area be opened to hunting like the rest of the forest or is this an opportunity to provide a refuge for nonhunters who would enjoy an outing during hunting seasons and a special use for the nonconsumptive wildlife user?

CONCLUSIONS

Private enterprise, organizations, State, county, and city facilities are

answering an obvious need. The National Forests meet yet another need. The land base and physical opportunities on the National Forest are staggering. It would be easy to get carried away with grandiose plans for golf courses and swimming pools. We must recognize that our greatest potential for the recreating public is the opportunity to provide solitude and elbow room. Our emphasis in allocations must reflect this need.

The actual acreage needed for meeting demands of occupancy-type recreation is insignificant to the whole on the National Forests. The problem is which acreage to occupy. Historically, camp and picnic grounds have been constructed on the prime lands adjacent to water. There is not much prime land available for further development. There is also a trend of reserving the prime lands for esthetic and ecological reasons. This trend places potential development sites in areas less desirable to the camper but more compatible to the overall picture.

Day-use activities such as picnicking can serve more people because of higher densities and turnover. A picnic site then would have a higher priority for prime lands if the demand was great enough.

Boating sites obviously must be near water. The selection of the boating site often dictates the design of a site because of the complexities of a launching ramp or carry-in lane. This is especially true of rivers that habitually have floods with high velocities.

Very few sites will meet all the criteria for a good swimming area. This places swimming in first priority for site selection.

Allocation priorities on multi-activity development sites become: (1) swimming, (2) boating, (3) picnicking, and (4) camping, assuming demand is relatively equal.

The factors of land capability, interest group pressures, present commitment, political pressure, and current policies must be welded into a decision for the allocation of land uses. We must recognize that these decisions are based on current, available information and circumstances. We must retain a degree of flexibility to change priorities and allocations. One real skill of land use allocation is to retain room for options.

ECONOMIC BASES FOR ALLOCATING RESOURCES IN OUTDOOR RECREATION

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ABSTRACT.--A review of the literature on economics as it relates to outdoor recreation suggests that the concept of supply and demand forces interacting in the market is a helpful way to look at the outdoor recreation problem. However, it is not clear how best to determine supply and demand in practice. The peak-load demand problem is characteristic of outdoor recreation. Differential pricing is suggested to redistribute use from peak to off-peak use periods. The cost of producing a user unit of activity (for example, a group-night of camping) is suggested as a guide to deciding whether or not new investment in facilities is justified.

THE PROBLEM

Forest land managers provide facilities and services that people want and need for outdoor recreation. Facilities may be as simple and primitive as a trail, or a two-rut road with few parking areas, or as elaborate as an intensively developed campground with an all-weather surfaced highway. The land itself, with its plant and animal life, can also be thought of as a recreational facility. Services may range from interpreting the natural ecosystem to picking up the garbage.

Providing facilities and services takes land, men, materials, and money. Typically, some or all of these are scarce resources to managers. Seldom are there enough resources to do all the jobs that could be done. Thus, the manager must decide the number and kinds of facilities and services, and where and when to provide them, to meet the varied and often conflicting outdoor recreation needs of people. He also must decide whether to charge for these facilities and services, and if so, how much and when.

Here economics may be able to help. Economics studies the allocation of scarce resources for producing goods and services to meet people's needs. It considers both private and public institutions and organizations created to produce and distribute these goods and services. Economics not only describes how things are, but suggests how efficient and equitable things should be (Scitovsky 1971, p. 5). It has developed a framework and tools for analyzing resource allocation problems that may be helpful in recreation.

DEMAND AND SUPPLY IN THE MARKET

One of the most helpful contributions of economics has been the concept of the market, in which the opposing forces of demand and supply interact to eventually establish a balance between price and quantity exchanged (Johnson 1968). A market can be defined for each good or service for a given time period and place. One of the distinguishing features of such a market is the idea that the amount that sellers are willing to sell and the amount buyers are willing to buy varies with the market price--in other words, there exist alternative levels of quantities demanded and quantities supplied. The economist attempts to develop demand and supply curves or functions by relating quantity to price (Milstein 1961). He assumes that once these have been determined, producers can use them in planning how much to produce and what price to charge.

Much traditional economic theory was developed to explain the pure competitive market in which many willing buyers and sellers, who individually have no influence on the market price and who have complete information and freedom to enter or leave the market, buy and sell identical products (Naylor and Vernon 1969, p. 43). In such a market the equilibrium price (P_e) is established by the intersection of the supply and demand curves (fig. 1). At this price the amount sellers are willing to supply just equals the amount buyers demand (Q_e), and a market equilibrium is reached. The competitive market, through the price mechanism, automatically allocates resources efficiently, giving rise

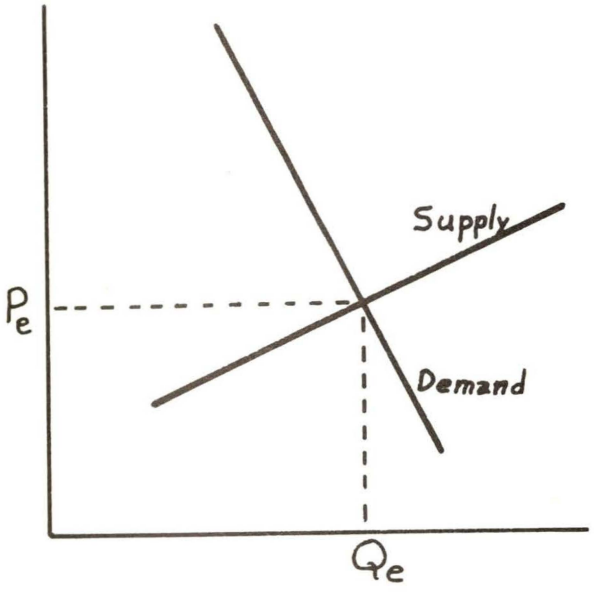

Figure 1.--*The equilibrium price (P_e) and quantity (Q_e) are established in a competitive market by the intersection of the supply and demand curves.*

to the idea of the market as the "invisible hand" that guides resource allocation.

Unfortunately, this ideal, pure, competitive market bears little resemblance to actual market conditions for outdoor recreation, where quantities and prices of unique recreation facilities typically are set by a few suppliers on a take-it-or-leave-it basis. Despite this, most economic theory applied to outdoor recreation problems has relied strongly on the pure competitive model, even though it may not be strictly applicable.

Obviously, if we are to study the allocation by the market of scarce resources to produce the outdoor recreation facilities and services people want, we have a two-part problem on our hands. First, we must know what facilities and services people want, how much, where and when. This is the demand part of the problem. Second, we must know what resources are available and what facilities and services can be provided by various means, how much, where, and when. This is the supply part.

In applying the economic concepts of supply and demand to outdoor recreation, some confusion has arisen because at times no distinction was made between the term "demand" and the terms "use" or "consumption." Supply and demand functions are schedules of alternative levels of production or consumption at various prices. Use or consumption estimates are single points reflecting the amount actually exchanged at the price established in the market.

Participation rates or past use has been used widely to project future "demand" for recreation. Typically, these rates are related to user or population characteristics such as income, age, or occupation. Unfortunately, the participation rates reported for recreation are not determined solely by demand factors such as distance traveled, education, and income, but also by the supply of recreation facilities available (Seneca and Cicchetti 1969). Use of participation rates to establish supply and demand curves gives rise to the "identification problem" in econometrics--the inability to identify whether changes in participation are due to changes in supply, or demand, or both (Cicchetti, Seneca, and Davidson 1969, Cicchetti *et al.* 1972). But many of these details are of a more technical nature, of interest primarily to an economist, and we will say no more about them. They do, however, affect the validity and believability of efforts to determine supply and demand.

Outdoor recreation facilities and services have, in the past, been provided by public agencies free of charge or at fixed prices administratively determined. Seldom, if ever, has the quantity provided or the price charged reflected either the cost of production or the willingness and ability of users to pay, as would be expected in market-priced goods. Without a market-established price as a guide, public land and managers and administrators have difficulty determining how much should be provided to allocate resources efficiently. With escalating costs and more careful scrutiny of budgets by legislators and others, administrators feel compelled to find methods for justifying expenditures on recreation facilities.

In the absence of a market price, economists have sought other ways of establishing a price or value of recreation. Trice and Wood (1958) used travel costs to a recreation site as the basis for estimating the value of a visitor-day, coming up with about $2 per day. Wennergren (1964)

argued that, "Cost expenditures can be used to establish value for a commodity that lacks conventional market pricing." He suggested that the "price" for boating should include the travel costs to and from the boating site plus the onsite expenditures for an individual user. Wennergren and others suggest valuing the resource on the idea of consumer surplus, the amount consumers would be willing to pay for a good or service over the amount they actually have to pay to get it.[1]

Many economists do not accept consumer surplus as a satisfactory measure of recreation value for comparison with other goods (Beazley 1961, Norton 1970, Beardsley 1971). They argue correctly that consumer surplus values should not be compared to market-price values, since these values are different. Market-price value corresponds to the old concept of value in exchange, while consumer surplus corresponds to value in use less the market-price value.[2]

Attempts have been made to establish demand curves by the direct method of asking users how much camping they would do at various fee levels (LaPage 1968). Fisher and Krutilla (1972) suggest this approach. This approach, of course, suffers from the uncertainty in relating what people say they would do with what, in fact, they will do, and from possible intentional biases in responses (Knetsch and Davis 1966).

One difficulty in trying to determine supply-demand curves for a particular recreation activity or site is the complex joint nature of recreation activities. Clawson and Knetsch (1963) identify five phases of the recreation experience: planning or anticipation, travel to the site, onsite experiences, travel back, and recollection. Each of these phases has its own costs and benefits (economic and social), occurring at different times, and it is necessary to consider the total cost of the whole experience in quantifying demand functions (Kalter and Gosse 1970). Also, any one activity may be part of a complex of activities forming a trip package. The demand for any one given site is strongly influenced by the supply of other recreation facilities and opportunities available, and often these change considerably over time (Clawson and Knetsch 1966). Then, too, the demand may be affected greatly by the quality of the site, and this in turn may be affected by the level of use and by size and scale of operations (Robinson 1967). All of this greatly complicates the job of deriving demand functions for a particular site, activity, and time.

A survey of the literature on the economics of outdoor recreation provides no clear idea of how to go about using the market approach to allocate resources. I can only agree with Beazley (1961), who over a decade ago concluded, "Presently we cannot measure consistently *any* values or benefits in an ultimate, comparable sense." Nevertheless, the basic concept of the market, that there exist alternative levels of supply and demand, and that both interact to determine the "best" level of production and consumption, is helpful in studying outdoor recreation (Castle and Stoevener 1970, Clawson and Knetsch 1963, Kalter and Gosse 1970).

SPECIAL CHARACTERISTICS OF RECREATION DEMAND

Anyone studying outdoor recreation immediately recognizes the wide range of people's needs and preferences for facilities and services (Hendee 1969, Hendee, Gale, and Catton 1971). Even for an activity such as camping the range is wide (King 1968, Lucas 1964, Merriam *et al.* 1973, Lucas 1970, Shafer 1969, Wagar 1963, West, McCool, and Merriam 1969). It is obvious that public agencies must recognize this diversity and provide a wide range of recreational opportunities (Goldin 1972, Krutilla 1967, U.S. Congress 1970). To meet user's needs we must better understand why people go where they do (Lime 1972). We must recognize that consumer's preferences and choices are affected by what is available--they can use only what is provided (Ciriacy-Wantrup 1963). Also, the quality of the recreation site, its location, design, and size affect the demand for the facilities. Thus, supply and demand are tightly woven to form the fabric of recreation activities.

[1] *Net consumer surplus is typically taken to be the area under the demand curve but above the market price (Wennergren 1964).*

[2] *For a brief discussion of consumer surplus see p. 436-437 in Samuelson (1973). For a detailed analysis of the concept see Currie, Murphy, and Schmitz (1971).*

But for outdoor recreation planning it is not enough to know the general level of demand. We also must recognize that user's time preferences vary widely and that users are constrained by weather, the school year, traditional work hours and work weeks, holidays, and other social and institutional forces in scheduling recreation activities. Because of this, much outdoor recreation use exhibits peaked-demand characteristics (Beazley 1961, James 1970, Goldin 1972). Many campgrounds filled to overflowing on a summer holiday weekend may be only 20 percent occupied during the weekday. Because outdoor recreation is strongly time-oriented, a campsite on a Wednesday in August is not equivalent to the same campsite on July 4th. The seasonal nature of many activities is evident (cross-country skiing, snowshoeing, waterskiing, sailing, canoeing), especially in northern areas. Hunting and fishing seasons are limited by law and so become highly time-oriented. Watching for migratory birds, driving to view fall colors, gathering certain mushrooms and berries, and many other recreation activities are typically concentrated into a short period, thus contributing to a peak-load demand for some facilities and services.

Variations in demand over time create problems in defining capacity and in designing facilities to meet demands. Do you design camping facilities to meet the average daily camping load, the average weekday camping load, the weekend peak load, or to meet the summer holiday weekend peak load? Can you design an element of flexible capacity into recreation facilities to meet peak-load demand? The answers to these questions depend in part on the time pattern of use for an individual facility. It may also depend on the cost of providing these facilities and services. Economics can provide information that may help decide these questions, and we will discuss only this aspect of the topic.

If an increase in the general level of demand for camping is expected, the part of this increase that occurs during off-peak periods when the campground is not fully used can be met, up to the capacity of the campground, at little extra cost. Only the demand in excess of existing capacity should be considered in planning for new facilities.

PRODUCTION COST AS AN ALLOCATION TOOL

One economic guide that may be helpful to the recreation manager in planning recreational facilities to meet anticipated demand is the production cost per unit of output. Knowing what it costs to provide a group-night of camping, a ski-touring trip, or a boat launching under different conditions may help the manager decide whether or not he can justify providing the facilities.

The annual cost of providing a user facility--say a campsite--can be determined by using standard investment analysis procedures. As an example, suppose the construction cost of a modern campsite in a national forest in the Lake States was $3,000, the annual maintenance was $50, and the reconstruction cost was estimated to be $1,000 every 20 years.[3] With a 5-percent discount rate, the annual cost (AC) of providing this site would be:

$$AC=0.05\left(\$3,000+\frac{\$50}{.05}+\$1,000\left(\frac{1}{(1.05)^{20}-1}\right)\right)$$

$$AC=0.05(\$3,000+\$1,000+\$600)$$

$$=\$230 \text{ per site per year}$$

With this information, together with expected annual use, one can estimate the cost of providing a group-night of camping. If annual occupancy is expected to be 100 group-nights, then the average cost of providing the campsite would be $2.30 per group-night. If the campsite will be used only 10 nights a year to meet peak demand on summer holidays, then the average cost is $23 per group-night. Obviously, the level of expected use can have a major impact on the anticipated cost of providing the facility. Lime (1971), in a study of campgrounds on the Superior National Forest, found a wide variation in use of individual campsites within campgrounds, including some campsites that had seldom if ever been used, and among campgrounds as a whole. If the campsite in our example were used only 1 night a year, whether through poor design, location, or excess capacity in the campground, the $230 it would cost to provide a group-night of camping would be hard to justify on any economic grounds.

This average cost information is useful in planning new facilities, but it has little relation to the cost of making the facility available to the user once it is

[3] *These figures are my educated guesses and are probably low. Nevertheless, they seem reasonable enough as a basis for discussion.*

built. The added or marginal cost of providing a group-night of camping in a campground that is not full may be essentially zero, except for the added cost of services and wear on the site. On the other hand, as the example above showed, constructing new facilities to handle excess demand that occurs only on summer holiday weekends could cost $20 or more per group-night of camping. This analysis doesn't tell us whether or not to construct new facilities to meet increased demand, but it may help us to understand how much it costs to meet different kinds of demand and to decide on a reasonable level of facilities based on expected use. Providing recreation facilities can be expensive, and managers should be aware of the cost of doing so, particularly if the expected use is light. Satisfying expressed needs and wants may be a noble goal, but price must be considered.

Our economic formulation of the campsite problem tells us that the cost per group-night can be lowered if the number of group-nights per year can be increased, but it also tells us that the group-night cost can be reduced by reducing construction and operations costs. Where use is light or only occasional, primarily during holidays or a few special days, perhaps the peak-load demand can be handled by cheaper, portable facilities, reduced facilities (unfurnished expansion camping areas), or temporary undeveloped camping areas, all of which might be considerably less costly to provide. This is, in fact, what managers sometimes do, with good economic justification.

This same general approach can be applied to a wide range of recreation facilities, including picnic areas, boat launching ramps, cross-country ski trails, and others. Knowing what it costs to provide the facilities and services for one unit of recreation experience (a group picnic, a boat launching, a cross-country ski tour, etc.) does not give a complete economic basis for allocating resources, but it can help the manager decide what level of facilities and services to provide.

PRICE AS AN ALLOCATION TOOL

Because prices for outdoor recreation facilities and services are controllable by the public agencies, price can be used as a tool to re-allocate use, at least to some extent. Goldin (1972), for example, suggests charging market clearing prices for each type of facility and each demand period. Some of the experience with handling peak loads in the public utilities industry may be of help here.[4] Regarding the electrical utility industry, De Salvia (1969) concludes that "peak-load pricing based on economic principles offers a practical solution to the problem of supplying peak loads." He argues that charging higher prices during peak-load periods and lower prices during off-peak periods would tend to depress peak demands and stimulate off-peak consumption.

In such a time-dependent activity as outdoor recreation, differential pricing might have a relatively small effect in distributing use over time. Nevertheless, it should be considered seriously as a potential management tool (Lime and Stankey 1971). Redistribution of use from peak-load to under-capacity use periods in effect provides new facilities by making use of unused facilities. Beazley (1961) and others have pointed out how effective recreation capacity could be increased by changing society's customs in the use of time, substituting Mondays for Saturdays as the "day off" for half the work force, rescheduling vacations, and so on. Although these actions are beyond the direct control of the outdoor recreation manager, they do emphasize an important principle. More outdoor recreation capacity can be provided not only by constructing new facilities, but also by making more effective use of existing facilities where they are now underutilized. From society's viewpoint, that may be the most efficient way of providing for some of the anticipated increased recreation demand.

A SUMMARY

In the time allotted we have only been able to consider briefly two aspects of economics as it relates to outdoor recreation. We have seen that the concept of supply and demand forces interacting in the market is a helpful way to look at the outdoor recreation problem, although it is not clear just how best to determine supply and demand in practice. We also have looked at the peak-load demand problem, characteristic of outdoor recreation. We proposed using cost of producing a user unit of activity (a group-night of camping, for example) as a guide to deciding whether new in-

[4] *For examples of a more comprehensive discussion of peak-load analysis see Brown and Johnson (1969) and Williamson (1966).*

vestment in facilities is justified or not, and suggested differential pricing to redistribute use from peak-use to off-peak use periods.

Time did not permit us to explore these subjects in any detail. Those interested can consult the references cited as a starting point. Neither were we able to investigate one important aspect of economics--the distribution of costs and benefits, the who-pays and who-gets part of economics. The literature relating to economic aspects of outdoor recreation is expanding rapidly.

I hope to have conveyed the impression that a considerable amount of work has been done on providing economic bases for resources allocation in outdoor recreation, even though it is still too early to see clearly how effective much of it has been. Although much remains to be done, the work done to date should demonstrate that economic concepts do provide a helpful way to view allocation problems in recreation, and some may provide a guide to management decisions.

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SOCIAL CARRYING CAPACITY FOR BACKCOUNTRY RECREATION

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ABSTRACT.--Carrying capacity in wildland recreation areas is a complex concept that relates to many aspects of use in addition to numbers of users. Management objectives are essential to provide standards against which changes caused by use can be judged as acceptable or unacceptable. Visitors' attitudes are a second essential factor in setting carrying capacities. Impacts of use on physical-biological resources are the third important influence on capacities. Social carrying capacity is considered in relation to "backcountry", defined as roadless recreation areas, but not classified Wilderness. Growing use, decreasing opportunities, and the lack of a comprehensive management program contribute to the problem of social carrying capacity. Social carrying capacity research to date is reviewed. It shows that solitude is a major attraction and influences satisfaction. Campsite privacy is particularly important. Mechanized recreationists value solitude less and detract from the experience of nonmechanized visitors. This is the major use conflict. Most visitors do not desire much in the way of facilities. Research results suggest environmental management in backcountry, especially for fish and wildlife, could be intensive. Projections point to rapid future growth in backcountry use. A more positive management program appears necessary to meet this growing pressure.

THE CARRYING CAPACITY CONCEPT

There is widespread and intense concern that many wildland recreation areas are threatened by overuse. One solution--establishing carrying capacities for specific areas--at first glance seems easy to do but upon close examination becomes extremely difficult (Wagar 1964). As Lime and Stankey (1971) point out, recreational carrying capacity is not a value easily arrived at. For a particular recreation area there is no magic number that "is *the* carrying capacity."

In fields such as range management, carrying capacity can be described in a relatively straightforward fashion. For that reason, some have suggested that the term "carrying capacity" is inappropriate in recreation management. However, the rationale for applying the carrying capacity concept to recreation is that (1) recreation provides a particular service to people; (2) the service (or the product of the recreation resource) is a result of the interaction between the individual, other users, and the resource; and (3) beyond certain limits, this product is adversely affected by excessive congestion, resource deterioration, or both. Finally, although the term "carrying capacity" may not be the best for the recreation context, it has been used so much that coining a new term seems unwise.

In defining recreational carrying capacity, we assume the goal of recreation management is to maximize user satisfaction. Within constraints--administrative and policy considerations, budgets, and resource capability--managers try to define the kind and amount of use an area can support over a specified time without causing an unacceptable change in either the physical environment or the recreational experience.

The crucial part of this process, of course, is deciding what constitutes "unacceptable" (or acceptable) change (Frissell and Stankey 1972). The answer lies in three interrelated determinants of carrying capacity: (1) management objectives; (2) visitor attitudes; and (3) impacts on physical resources. No single factor sets capacity; all are important, but their relative significance varies from one opportunity to another.

MANAGEMENT OBJECTIVES

Capacity can be judged only against the management objectives for a specific area--objectives that define the recrea-

tional opportunity (or opportunities) the area is intended to provide.

A variety of opportunities is needed, but this does not mean each manager must try to provide an endless variety of different types of areas. Burch (1964) pointed out that although a wide range of recreational tastes exists, certain activities tend to go with one another. These "activity aggregates" impose certain demands on the resource and have certain effects on other uses. Regionwide planning is needed to meet the diversity of recreational tastes. However, "no one recreation supplier need feel obligated to meet all demands. Each public agency could aim clearly at a part of the demand, and refer people who want something more, less, or different to a more appropriate area" (Lucas 1963b). This requires coordination, as well as informing the public who is providing what and where.

Management objectives are standards against which managers judge whether or not use is consistent with an area's carrying capacity. If objectives change because of agency policy, public pressure, or other reasons, so does the definition of what is appropriate and what is not. In the absence of clear objectives, however, attempts to make consistent and defensible judgments about capacity will be futile.

VISITOR ATTITUDES

All recreationists do not perceive the environment in the same way; what is a quality recreational experience to one may be unsatisfactory to another. What the recreationist perceives as acceptable or desirable also may be quite different from what the manager perceives and from what the manager *thinks* the public perceives (Stone and Taves 1958, Lucas 1964b, Hendee and Harris 1970). In a study of National Forest campgrounds, Lucas (1970) found visitors ranked recreational site quality very differently (usually higher) than did Forest Service administrators.

Defining recreation standards and objectives involves *values*. Whose values are to count most--the managing agency's or the public's? If public values are to be relied upon, which "public"?

It is impossible to please everyone everywhere, and some attitudes *are* more relevant than others. "It seems misleading to give equal weight to evaluations by people who are seeking a different type of area or experience" (Lucas 1970). If we provide a full range of opportunities (regardless of the agency or organization that provides them), we can match visitor needs with opportunities rather than try to develop recreation areas for the mythical "average user" (Shafer 1969, Wagar 1966); a process that could gradually dissatisfy almost everyone.

Although management cannot base decisions solely on public opinion, visitor attitudes are a good indication of how well management objectives match user objectives. From this, we can define the spectrum and the mix of opportunities needed. Furthermore, attitudes also indicate how visitors might respond to specific management actions. Knowing who may dislike a given management action and explaining why their preferences cannot be met can be as important as deciding for whom the area will be managed (Lime 1972). Surveys of public attitudes can give objective, unbiased feedback to the manager. A manager confronted by a few complaints may overreact if he has no way of tapping the opinions of the majority who usually come and go quietly.

IMPACT ON PHYSICAL-BIOLOGICAL RESOURCES

How much wear and tear of the resources should the manager permit before he says, "that's enough"? Recreational impact on physical-biological resources is the third component of carrying capacity.

Any use of an ecosystem results in some change; Frissell and Duncan (1965) found that only light use of camping sites in the Boundary Waters Canoe Area (BWCA) removed over 80 percent of the ground cover. Even in locations managed to maintain a natural or near-natural setting, we must accept less than total achievement of the goal if we allow any use at all.

The manager must know (1) what change will occur under specific levels and types of use, and (2) how the change relates to the management objectives for the area, taking into account how people perceive and respond to changes in the physical environment (here, social and ecological aspects mesh because both help to define unacceptable changes). If the predicted change is inconsistent with objectives, the manager has three options: (1) ignore the problem and take no action; (2) change the management objectives (e.g., from low-density to high-density recreation); (3) prevent predicted change, through design, restrictions, or facilities.

The manager takes action based on how a change relates to management objectives, rather than directly on the change itself. In a developed, high-density-use campground, the manager could use many techniques to counter resource damage; for example, paving, or planting hardy species. However, at a hike-in campsite where the objective is to provide a camping opportunity in a fairly natural setting, and where the amount of resource change permissible would be comparatively small, the manager probably would have to rely more on use restrictions (numbers of people, kind of use) rather than on techniques that "harden" the site.

THE BACKCOUNTRY CONCEPT

We use the term "backcountry" to refer to any area where the management objectives stress dispersed, off-road recreation activities: hiking, cross-country skiing, snowshoeing, snowmobiling, trail bike riding, canoeing, boating, river floating, horseback riding, hunting, fishing, bird watching, camping, and others. We consider backcountry a recreation area, in contrast to Wilderness, which we define as primarily a large natural ecosystem, to be experienced as it is. By definition, recreational opportunities could be enhanced or even created in backcountry, but not in Wilderness. Educational opportunities could also be expanded in backcountry, through roving naturalists, interpretive signing, trailside exhibits, and so on.

If one pictures a spectrum of recreation opportunities (Lloyd and Fischer 1972) ranging from highly developed to undeveloped (fig. 1), backcountry spans a range of opportunities from wilderness to, perhaps, areas accessible by jeep.

Most backcountry should be relatively natural but not to the extent of wilderness. The degree of naturalness would depend on where an area's objectives fall on the spectrum. Intensity of recreation would be light, but generally would not provide the solitude offered by wilderness.

In the midwestern United States and the Great Lakes region of Canada, several recreation areas would meet our definition of backcountry (not wilderness), at least in part, to name a few: Algonquin Provincial Park, Ontario; Porcupine Mountains State Park, Michigan; Sylvania Recreation Area, Ottawa National Forest; Namakagon River, Wisconsin; and the Pine River, Michigan. Additional examples from other parts of the country could be cited, such as the Jewel Basin Hiking Area, Flathead National Forest, Montana.

THE PROBLEM

Three factors contribute to the problem of social carrying capacity for backcountry--soaring use, decreasing opportunities, and the lack of a comprehensive management program.

Use--Substantial and Growing Fast

Interest and participation in primitive recreational experiences has been booming. Although we are concerned here with a wider range of activities, wilderness use is one index of this boom. Between 1950 and 1970, reported visits to the National Forest Wilderness and primitive areas increased ninefold, while nonwilderness recreation tripled. In recent years, about one-fourth of the reported National Forest recreation visitor-days were spent on trails and "general undeveloped areas," including

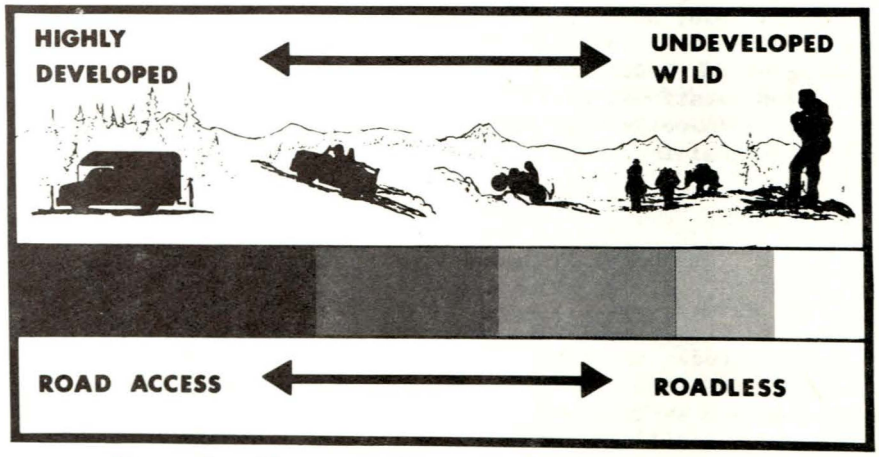

Figure 1.--The recreation opportunity spectrum.

Wilderness (although the greatest part of of the use is outside Wilderness). Another 12 or 13 percent were spent on lakes and streams, some of which would be backcountry as we have defined it. Again, use statistics show high rates of growth. Recently, dispersed mechanized recreation (snowmobiles and trail bikes, mainly) has exploded (Lucas 1971).

Opportunities--Limited and Declining

Outside established special areas, undeveloped lands are scarce, especially in the Midwestern and Eastern United States, and almost surely declining as roads and other developments break the remnants into ever smaller and less significant pieces. Outdoor Recreation Resources Review Commission (ORRRC) Report 8 (1962b) showed 98 percent of sample air photo points in the Northeastern United States were within one-half mile of a road--and that was over a decade ago! Private land, especially shorelines, that once provided much backcountry recreation is being developed at a fast pace (Borchert *et al.* 1970). Trail systems are being gradually whittled away by roads and trail abandonment, and new trail construction has not kept pace (Lucas 1971).

Backcountry recreation calls for low-intensity use and a degree of solitude. Thus, growing use on a dwindling land base will lower the quality of the experience. This is already a problem many places, as indicated by complaints about streams overloaded with canoes, overflowing trail shelters, and so on. Furthermore, the boom in both mechanized transportation (trail bikes, snowmobiles), and more primitive transportation (backpacking, horses) intensifies conflicts and poses severe problems in social carrying capacity.

Management Programs--Limited and Stalled

A comprehensive program for a system of backcountry recreation areas does not exist. There are scattered, individual examples--and we named a few--however, most opportunities are on lands unmanaged or, at best, minimally managed for backcountry or dispersed recreation. These are mainly leftover lands, and informal backcountry use is unplanned for, not really an objective for the area. The lack of objectives and the absence of management programs intensify and accelerate the loss of opportunities for backcountry recreation. Intensified management could probably raise the recreational capacity of backcountry areas appreciably. However, to do this, we need a much better grasp of the social aspects of carrying capacity.

WHAT IS KNOWN ABOUT SOCIAL CARRYING CAPACITY?

Research dealing specifically with backcountry, especially in the Midwest, is limited. There have been studies of visitors in Algonquin Provincial Park,[1] the Adirondacks (Shafer and Mietz 1969), Michigan's Pine River (Solomon and Hansen 1972), and some other backcountry areas. In addition, a few studies discuss recreational activities like snowmobiling that could be important in backcountry. Although few of these studies were focused on carrying capacity, some of their results are pertinent.

The recent annotated bibliography on carrying capacity by George Stankey and Dave Lime (1973) lists over 200 publications; about 50 pertain to what they call "esthetic carrying capacity" and 60 more relate to "managing for carrying capacity."

Most of our knowledge of backcountry carrying capacity must be borrowed or adapted from studies of Wilderness visitors. Social carrying capacity has been studied in depth, particularly in the BWCA of the Superior National Forest (Lucas 1963a, 1964a, 1964b, 1964c, 1965; Lime 1972; Stankey 1971, 1972, 1973), Adjacent Quetico Provincial Park in Ontario has been studied also (Lusty 1968). This research has considerable transfer value for understanding backcountry social carrying capacity.

Mountainous terrain and greater use of horses may make it difficult to adapt western Wilderness studies (Hendee *et al.* 1968, Merriam 1963, ORRRC 1962a, and research in progress by Lucas and Stankey) to the Midwest. One study that includes the BWCA and three western areas (Stankey 1971) concluded that although differences among individual areas would always have to be weighed when prescribing guidelines for carrying capacity, there are, never-

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[1] *George B. Priddle. Wilderness perception in the Algonquin Park interior. Unpubl. M.S. thesis, Clark Univ. Grad. Sch. of Geogr., Worcester, Mass. 1964.*

theless, certain broad, generic appeals about wilderness that appear unaffected by particular area characteristics. For instance, the idea that wilderness should offer an opportunity for solitude is accepted regardless of the levels of use, resource variability, or proximity to population centers. On the other hand, certain unique characteristics, such as a predominance of horse use, do give rise to differing ideas as to what is appropriate or desirable use.

Type of Experience Sought

The type of recreation experience sought has some important aspects: levels of use or solitude desired, conflicts among various recreation activities, compatibility with commodity production, specific activities desired, importance of area size, and need for overnight as compared to day-use opportunities.

Solitude

Studies of Wilderness and backcountry show most visitors want solitude and that past some unspecified threshold of use, satisfaction declines.

Social carrying capacity has been studied mostly in Wilderness. In the Boundary Waters Canoe Area, Lucas (1964a) found canoeists objected to encountering other visitors more than did motorboaters and motor canoeists. Canoeists defined crowding not only in numbers of people, but also in types of use (specifically disliking motorboats). On lakes where total season use was less than 300 groups of canoeists, most canoeists felt that crowding had not destroyed the wilderness experience. Where motorboats were found, however, canoeists felt crowded at a much lower level of use. In his study in the BWCA and three western Wildernesses, Stankey (1971) found tolerance to crowding was a function not only of the level and type of use encountered, but also of where and when the encounters took place, and the behavior of visitors. Campsite privacy was more important than encounters while traveling. Most visitors wanted to camp out of sight and sound of other parties, but most reported their satisfaction did not drop substantially until they met more than about two or three parties a day while traveling. Littering was disliked even more intensely than crowding.

On the heavily used Pine River in Michigan--about 1,000 canoeists on a typical Saturday or Sunday--about one-fifth of the visitors still gave "solitude" as a reason for their trip (Solomon and Hansen 1972). Again, "littering" was the most common complaint and "too many people" rated second. Complaints about crowding came almost entirely on weekends when use was heaviest. Quetico Provincial Park visitors also complained most about littering, and next most often about visitors using outboard motors--general crowding was third (Lusty 1968). One-third of the visitors said they sometimes felt crowded and were bothered by more than two parties on the same lake, full campsites, and motorboats. Again, campsite privacy was important--85 percent wanted to camp away from all other visitors.

Algonquin Provincial Park canoeists rated a lack of people the second most important attraction; fishermen rated it sixth. The canoeists' main reason for preferring Algonquin to other areas was "lack of people" (Priddle *et al.*, n.d.) Again, most Algonquin visitors wanted to camp out of sight of other parties.

A study of Adirondack hikers did not ask directly about solitude, but we can infer its importance from the fact hikers rated "social motivations" last as a reason for hiking (Shafer and Mietz 1969).

Mechanized recreationists are much less concerned with solitude and tolerate or enjoy heavier use than nonmechanized visitors (Lucas 1964a, 1964b; Lusty 1968; Stankey 1971; Lucas, study in progress). They are more interested in fishing than the nonmechanized users (Lusty 1968, Lucas 1965). Unpublished data from visitor surveys in Montana and Idaho (Lucas) also suggest more emphasis on hunting and fishing in backcountry, than in Wilderness, but this was most true in an area where airplane access was common, and this mechanized access may be the main explanation, rather than the fact the areas were backcountry.

In summary, solitude is an important value for nonmechanized users of backcountry, but the level of solitude desired for particular types of backcountry areas must be determined through future experience and research. For the wilderness-like areas, we do know that isolated campsites are generally best, rather than sites clustered in campground-type designs. Daily encounters with other parties while traveling in backcountry should probably not exceed two or three per day at the wilderness end of

the spectrum and range upward for areas toward the developed end of the spectrum. How high this level of use might be cannot be determined from present knowledge.

Use Conflicts

The major conflict is between the mechanized and nonmechanized recreationists. Most of the nonmechanized visitors have a strong aversion to mechanized use. Studies of reactions to motorboats and trail bikes (Lucas 1964a, 1964b; Hendee *et al.* 1968; Stankey 1971; Lucas, research in progress) uniformly show this aversion. Conflicts between snowmobile operators and cross-country skiers and snowshoers are also intense.[2] It is a one-way conflict; the mechanized users do not dislike the nonmechanized users.

To us, the conflict seems severe enough that areas open to mechanized, dispersed recreation must be recognized as unsuitable for nonmechanized uses; trying to combine both appears unlikely to succeed. Zoning separate areas for each use seems logical, especially because of the different visitor motivations mentioned before (e.g., mechanized visitors are more interested in fishing), the lower importance mechanized visitors attach to solitude, and their greater acceptance of heavy use.

There are also serious conflicts involving large parties--smaller groups of visitors strongly dislike large groups (Stankey 1971).

Horsemen and hikers conflict, but to a much lesser degree than mechanized and nonmechanized visitors. Most hikers feel horse travel *is* appropriate in Wilderness; however, most of them prefer meeting other hikers and some of them are bothered by the physical damage horses cause on trails and at campsites (Stankey 1973).

Compatibility with Commodity Uses

There is little data on this issue. Canoeists on the Pine River did not complain about a dam they had to portage around (Solomon and Hansen 1972). Visitors to Quetico Provincial Park (Lusty 1968), the Boundary Waters Canoe Area (Lucas 1963a), and Algonquin Provincial Park[1] (Lucas and Priddle 1964) generally did not notice the carefully controlled logging in these areas. When they did, about 50 percent complained. However, the *idea* of logging in backcountry seems even more objectionable than the reality; when asked, most visitors reject the practice (ORRRC 1962a).

Types of Activities Desired

Studies suggest that in backcountry a diverse mix of activities is important, but that fishing, and perhaps hunting, are key values, more so than in Wilderness. This is especially true for mechanized recreationists and much less true for river canoeists and floaters--only 4 percent of the Pine River canoeists fished (Solomon and Hansen 1972). The opportunity for off-road travel itself is the other key value. Swimming, camping, nature study, and so on can all be important.

Area Size

Size of backcountry areas can be highly variable; in some cases they might be quite small (Hutchison 1962). The studies cited indicate that as size increases, lengths of stay also increase, and more visitors come from outside the local area--probably indicating the area has greater perceived significance. Total capacity also increases as size increases, of course, although probably at a declining rate (a curvilinear relationship between size and capacity) because much use is brief and marginal, and fringe areas are usually crowded before the core is fully used. This is not necessarily inefficient; in fact, it provides greater diversity of experience and can be very desirable.

One would think mechanized recreationists would require a larger area because such rapid transportation consumes space faster than nonmechanized means of transportation. This may be true for snowmobiles[2] and perhaps trail bikes--we are unaware of any relevant data on trail bikes--but motorboats and motorized canoes actually penetrate *less* deeply into the BWCA and Quetico Provincial Park than paddlers at a time when no zones were closed to motorized use (Lucas 1964c). This is probably because those in motorboats were mainly interested in fishing; the canoeists wanted a broader, more diverse experience.

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[2] *William Brown Mahoney. Winter recreation conflicts in two areas near Missoula, Montana. Unpubl. M.S. thesis, Univ. Montana, Missoula. 1973.*

Day Use vs. Overnight Use

Day use of backcountry areas is very common, especially on the smaller areas. About 60 percent of the Pine River canoeists were day-users (Solomon and Hansen 1972). Over half of the visitors were day-users in four Montana Wildernesses and backcountry areas smaller than 100,000 acres (Lucas, study in progress). Even the Selway-Bitterroot, largest Wilderness in the Nation, has almost as many day-users as overnight users, although the three other large areas studied had from only 14 to 40 percent day-use.

Mechanized use runs heavily to day-use. In the BWCA, Lime and Buchman (1973) report day-users made up 95 percent of snowmobilers, 65 percent of motorboaters, 37 percent of motor canoeists, but only 23 percent of paddling canoeists. Limited unpublished data (Lucas, study in progress) indicate trail bike riders also are overwhelmingly day-users.

Visitors to Wilderness and backcountry areas reveal mixed attitudes toward level of development, management practices, and use regulations. This emphasizes the need for diversity, which could be furthered by backcountry areas to supplement Wilderness and by diversity within and between backcountry areas.

Level of Development

Different factors relate to social carrying capacity for day-users and overnight campers. Campers prefer campsite seclusion and not meeting too many other parties traveling. We believe day-users will accept less solitude and tolerate heavier use than overnight visitors. If this proves true, then overnight campers become the group to consider when establishing social carrying capacity for any area with significant overnight use.

Management Preferences

Most Wilderness visitors studied favor little or no development--fireplaces, tables, and high-standard trails are all opposed by more than support them (Hendee *et al.* 1968; Stankey 1973; Lusty 1968; Lucas, study in progress). The study by Hendee showed more visitors favored outhouses than opposed them; in other studies (in different areas) the reverse was true. Most users favored bridges, especially across large streams. Although the general preference in all areas studied is towards relatively undeveloped conditions, all studies show substantial minorities who *do* prefer more development. This is especially true of the mechanized travelers. Bridges and outhouses are the most desired and least objectionable developments. Loose rock fireplaces on which visitors can place their own grill seem preferable to cemented iron grates. In most places tables are an unnecessary expense. Where they are provided, split log tables are highly preferred to plank construction.

Generally, facilities should be developed with restraint, only where a clear need exists, and not just for the sake of building something.

Environmental Manipulation

Backcountry opens up exciting possibilities for enhancing recreation opportunities in ways ruled out in Wilderness. The importance of water for fishing, scenic beauty, and campsite settings suggests that small, earthen dams to create natural-appearing ponds and lakes could be very beneficial. Intensive fish management seems essential. We have asked visitors to western Wilderness about many management options and one of the most unpopular was "natural fishing--no stocking and barren lakes left barren."

Wildlife habitat could be improved through practices such as prescribed burning, creation of small openings, planting some critical food species, and so on. Wildlife management in backcountry should usually consider nature observation as much or more than hunting. Songbirds and chipmunks can add much to a trip, for example.

Scenery could be enhanced also. Trails should be laid out to take full advantage of views near and far (Shafer and Mietz 1969, Lucas 1971). Beyond this, the quality of recreation could be improved by skillful manipulation: removing a few trees to open a vista, planting flowering shrubs or varieties that have brilliant fall coloring, making a small meadow by a pond, and perhaps thinning a patch of timber to encourage development of a "cathedral grove" of large trees. Adding new attractions, and thus dispersing visitors to new destinations and camping areas, could increase social carrying capacity.

Again, there is need for a range of policies under the backcountry heading--some areas should be modified very little, if at all, and others could gradually be

enhanced very substantially, almost created, especially in areas previously altered by man's use.

Practices to protect or restore sites damaged by use could be more varied than in Wilderness. More use-resistant species could be planted, fertilized, and watered. If advantageous, non-native species could be planted in backcountry, unlike Wilderness.

Trail Systems

We have just stressed the importance of making trails conducive to esthetic experiences. Capacity can also be enhanced by laying out trails and adding side trails so visitors explore more country rather than just reach a destination as fast as possible. Trail design also can reduce visibility between parties and thus enhance solitude. One-way loop trails in high-use areas could greatly reduce encounters between parties

Use Regulations

In every study cited above that investigated the issue, Wilderness and backcountry visitors were receptive to use controls, more so than managers usually expect (Hendee and Harris 1970, Hendee and Pyle 1971). Regulation, if and when necessary, should not be delayed by visions of violent public opposition. Manipulation of access--making access more difficult or time-consuming by blocking off the last few miles of roads, for example--ranks first with visitors (Stankey 1973); a mail reservation system ranks second. Absolutely the most unpopular way to regulate use would be for the managers to assign itineraries and campsites (Stankey 1973; Lucas, research in progress).

Use Projections

All indications are for continued rapid growth in backcountry use (or potential use, if opportunities for its expression are lacking). Projections for Wilderness use (ORRRC 1962a, USDA Forest Service 1959, BOR 1967), all predicting faster growth than for most types of outdoor recreation, have consistently underestimated the use that actually occurred. Booming sales of backpacking equipment, snowmobiles, and trail bikes are another symptom of recent rapid growth.

All studies show that Wilderness visitors predominantly come from social-economic categories that are growing rapidly and are projected to continue expanding: urban, well-educated, professional occupations, moderately high incomes. Mechanized recreationists are more often from small towns or rural areas, average or below in education, and from blue-collar occupations (Lucas 1971). These segments of the American population are slowly growing or are declining, and their use potential may level off.

SUMMARY AND CONCLUSION

The need for a more dynamic backcountry recreation program is amply documented by a wide variety of research. The gap in the middle of the recreation opportunity spectrum is obvious. It may be difficult to obtain political support for intermediate, compromise positions because both past recreation programs and much of the organized, vocal public have been polarized. Nevertheless, the potential use and public benefits of a variety of backcountry areas cannot be denied.

Although a backcountry recreation program and its social carrying capacity aspects have been outlined, we have drawn mainly on studies of Wilderness visitors. Research is adequate to help formulate new backcountry programs and help managers as they develop first approximations of social carrying capacity. However, more precise, specific guidelines can come only from future research addressed directly to different kinds of backcountry areas and their uses. We emphasize again the importance of clear objectives in developing new areas and evaluating their capacity.

Cooperative pilot projects involving area managers and researchers are particularly necessary. New programs could be developed from present knowledge and imaginative, creative, new ideas. At the same time, plans could be made to objectively monitor public response in terms of use, satisfaction, and attitudes about specific management actions. Substantial benefits for the public could come out of this type of partnership.

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ECOLOGICAL CARRYING CAPACITY

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ABSTRACT.--Carrying capacity can be defined only in terms of the management objectives for a specific area. Management objectives should be determined by interagency regional planning so that each agency provides only those recreation opportunities that correspond best to its mission and to the nature of the landscape under its jurisdiction. Within management constraints, sites can be hardened to provide the recreation opportunity called for by the management objectives. The problem often is that the hardening process alters the character of the area beyond the limits of acceptable change for the recreationist. More research is needed to provide hardening techniques that will protect the resource yet not alter the recreational character of the area.

In traditional ecological usage, carrying capacity is a complex concept broad in meaning, but it can be defined in a general way as the total number of individuals of a species that can live in an ecosystem (or habitat) under certain conditions (Knight 1965). The "certain conditions" causing the complexity include individual, population, and environmental (weather, food, other organisms, and a place to live), interactions (Krebs 1972), and feedback mechanisms.

In man-dominated or controlled ecological systems the term has come to mean the number of a species the environment can support on a sustained yield basis (for example, the number of cattle per acre per year). This concept of carrying capacity has been traced by Wagar (1964) back to man's earliest history with regard to the capacity of the land to produce enough food for the human population.

In recreation, carrying capacity has received much attention only since the 1960's (Brandborg 1963, James and Ripley 1963, Lucas 1964), but the concept is much older. Overcrowding in national parks and consequent loss of wildland values were noted in the 1930's by Adams (1930), Meinecke (1932), and Leopold (1934). And Wagar (1964) recognizes the same concept in the restriction of hunting rights to the nobility during the reign of Charlemagne (768-814 AD).

Taking earlier attempts at defining recreational carrying capacity into account, Lime and Stankey (1971) defined it as "... the character of use that can be supported over a specified time by an area developed at a certain level without causing excessive damage to either the physical environment or the experience of the visitor." This has been paraphrased by Frissell and Stankey (1972): "What are the environmental and social consequences of a given level of use over a certain period of time?"

Lime and Stankey distinguish three aspects of recreational carrying capacity: management objectives, visitor attitudes, and impact on the physical resource. The impact on the resource (ecological aspect of recreational carrying capacity) is our specific topic, but as Lime and Stankey point out, the three aspects are interdependent, no one being necessarily more important than another. Because one aspect cannot be discussed without occasional reference to the other two, some of this discussion will overlap topics assigned to other participants in this symposium.

RECENT LITERATURE

Ditton (1969) in a detailed review of literature dealing with water as a recreation resource states that the most definitive "... state-of-the-knowledge..." publication on recreation carrying capacity to 1969 is that of Chubb and Ashton (1969). Ditton sees good agreement about the physical, social, attitudinal, and

behavioral factors involved in establishing optimum recreation use (carrying capacity) as expressed by Anderson (1959), Lucas (1964), Wagar (1964), and Chubb and Ashton (1969).

In their chapter on the nature of recreational carrying capacity Chubb and Ashton (1969) enumerate as site factors: a) geology and soils (as they affect drainage and vegetation; i.e., the more fertile soils are able to withstand high levels of use and better maintain a satisfactory ground cover than less fertile soils), b) topography and aspect (as they affect slope and thus soil erosion and microclimatic influence on the flora and fauna), c) vegetation (its ability to tolerate varying intensities and types of recreational use), d) climate (as it influences length of season available for a given recreational use), e) water (availability for domestic, irrigation, and recreational use), and f) flora and fauna (especially where they are the basis for the recreational use of an area). These factors all play an important role in determining the ability of a site to withstand recreation pressure.

Lime and Stankey (1971) have published the most recent extensive and intensive review of the recreation carrying capacity literature and an annotated bibliography (Stankey and Lime 1973). They conclude that there are many possible capacities for a given recreation area and that determining capacity requires a consideration of the values of a variety of publics and the area's resource resistance to recreational use. They emphasize that recreationists who appear superficially similar may not have identical recreational needs or perceptions of the environment (they may not perceive environmental degradation the same either). These authors recommend that administrators use alternatives other than rationing to manage for a given carrying capacity; for example, site management (barriers, hardy vegetation, etc.), regulating visitor behavior (zoning, reservations, etc.) and modifying visitor behavior (fees, information services).

Since Lime and Stankey (1971), Tivy's (1973) literature review on recreational carrying capacity and several other conceptual papers have appeared that add depth to the ecological aspect of recreational carrying capacity (Conservation Foundation 1972, Lloyd and Fischer 1972, Fisher and Krutilla 1972, Frissell and Stankey 1972, and Hopkins *et al.* 1973).

Tivy (1973) summarizes the most significant and relevant USA research through 1971 on the problem of defining and determining recreation carrying capacity. The paper also contains a limited annotated bibliography on carrying capacity. Tivy concludes that recreation cannot be compared directly with other types of land use in terms of land or capital intensity. She compares recreational land use to use of land for animal grazing and concludes that just as the sheep farmer, cattle rancher, and gamekeeper need to know the stock carrying capacity of their lands, managers of recreational land must know what the results of varying intensities of recreational use will be.

Although the Conservation Foundation report (1972) is addressed specifically to national parks, two aspects of the paper seem applicable to ecological carrying capacity on any wildland. First, the report refers to a physical carrying capacity: "... the effect of visitation on the nonliving aspects of the habitat"; i.e., the ability of a particular terrain to resist trail erosion, but also the ability of the terrain to "absorb" trails, roads, and other man-made objects. It also refers to an ecological carrying capacity as "... the effect of visitors on park ecosystems."

From an ecological point of view, the two capacities actually cannot be separated. The nonliving and the living by definition are both part of an ecosystem. An alternative interpretation might be that it attempts to differentiate the macro versus the micro impact of recreational use on the resource. Thus, the impact of use on a particular trail or campground may be quite severe, but if it constitutes only a very small percentage of the total resource of the recreational area, it can be viewed as a micro-impact problem. And the question of how many trails, roads, campsites, etc., the whole recreational area can contain without degrading the area as a recreation resource is a macro impact. The latter seems to be more of a subjective evaluation of an objective setting for an area.

A second pertinent aspect of the report is the idea that recreation management of an area should be based on a judgment of the appropriate carrying capacity and that this judgment should be *a political one* "... grounded in both expert evaluation of the resource and in the interests of the people who use or could use the park." The idea that the carrying capacity be based on a political judgment did not originate with this report but perhaps it is stated more emphatically than before. Lime and Stankey (1971) say that "... capacities can be defined only in light of the objectives for the area in question" and they too discuss the role of people's interests in setting capacities and objectives.

Lloyd and Fischer (1972) emphasize an aspect of ecological carrying capacity discussed by earlier workers (Wagar 1966, Lime and Stankey 1971); i.e., the concept that there is a continuum of recreational demands from dispersed to concentrated types. Lime and Stankey indicated that providing a wide range of recreational opportunities to choose from within a region will help visitors maximize their enjoyment. Lloyd and Fischer suggest criteria for doing this, including space requirements, participant interaction, participant objectives, the character of sites and facilities, accessibility, and mode of transportation. Lloyd and Fischer feel that people's preferences and objectives are the crucial considerations in providing any kind of recreation.

Fisher and Krutilla (1972) discuss a way to define and measure carrying capacity in wilderness areas in accordance with economic principles. They assume that in wilderness the factor that limits capacity is user perception of a quality experience (solitude) and not user impact on the resource. They suggest capacity be set through a type of cost-benefit analysis of congestion. They relate the benefits of successive days of wilderness use to the number of user encounters. As a measure they use the amount that wilderness users would be willing to pay for differences in the quality of the experience defined in terms of freedom from congestion.

Frissell and Stankey (1972) develop in more detail an idea expressed earlier by Lucas (1964), that physical deterioration of the resource is more likely to be indirectly limiting by reducing visitor satisfaction than by deterioration of the site itself. Thus, the physical capacity for use might be easily raised by hardening sites, etc. (assuming sufficient funds). Frissell and Stankey emphasize that there are "limits of acceptable change" imposed through user perception (at least for wilderness users) that may be more restrictive in terms of capacity than actual physical or ecological limits.

Hopkins *et al.* (1973) are primarily concerned with recreation planning from an economic viewpoint, but their comments also apply to ecological carrying capacity. They stress that managers need to have clear agency objectives before analyzing recreational alternatives.

APPLICABILITY OF THE RESEARCH

Based on the review of earlier papers and the recent conceptual papers described above, perhaps we can agree that the current "state-of-the-knowledge" of ecological carrying capacity is about as follows:

There is a continuum of recreational demands from dispersed to concentrated types for any landscape.

Over any broad landscape there is a corresponding continuum of response levels possible by the resource (ecosystem) to recreational demands that might be imposed. These responses are what determine the ecological carrying capacity of a recreation area.

Researchers recognize that there are some types of recreation use within the demand continuum that conflict with each other (snowmobiling and snowshoeing). The conflict may involve the nature of the experience each type of user is expecting to derive from his activity or it may be that the activities themselves cannot use the same piece of land (snowmobiling and cross-country skiing). In the same sense, there are possible severe conflicts between activities within the demand continuum and the resource (off-road recreation vehicle use over fragile soils, etc.).

The time to match potential recreation uses with each other and with the resource is in the planning stage when management objectives are being defined. Managers

will soon be expected to provide the appropriate recreational opportunities on the most appropriate areas and not (as may often have been the case in the past) provide for demands where users have "created" them through custom or tradition.

Through planning, improper matching of use and resource can be avoided and a minimum hardening of sites required to withstand the recreational impact. Thus, although ecological carrying capacity can be a limiting factor, within management constraints (laws, directives, finances, etc.) sites can be hardened to provide the type of recreation called for by management. The problem arises in the way the site is hardened. The types of facilities and designs for protecting the resource often alter the character of the area to the point where it becomes unacceptable to the user. The user is displaced and must find other areas that will satisfy his need.

By defining management objectives on a regional basis, we can provide more recreational opportunities within the continuum of recreational demands and avoid more resource conflicts. We should recognize that each public agency and the private sector cannot (or need not) provide all types of recreational opportunities. Interagency regional planning could result in each public agency, and the private sector, providing the kind of recreation that best meets the agency mission and best "fits" the nature of the resource under the agency's jurisdiction.

FUTURE RESEARCH

Research is needed to provide techniques and information for regional interagency planning so that landscapes of differing ecological capability can be matched more closely to recreational demands. Matching will reduce both social and resource incompatibilities while maximizing recreational opportunities.

Research on the techniques of hardening sites is needed so that: a) a minimum of energy (money) is required; b) any change in the character of the area is acceptable to users; and c) the resource is protected.

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ECOLOGICAL IMPACTS OF OFF-ROAD RECREATION VEHICLES

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ABSTRACT.--More than 5 million off-road recreation vehicles (ORRV's) are in existence today in the United States. Negative ecologic and sociologic impacts are inevitable and resource managers must be prepared to deal with them. Most land managers deal with broad landscapes, and thus must have information relating to ecosystems. In the case of snowmobiles, research is still rudimentary and no definitive studies of their impact on ecosystems have been done. While not considered in this paper, literature on other types of ORRV's is also probably lacking. Snowmobile impacts on the ecosystem can be inferred from a review of the literature on the structure and mechanics of snow and the significance of snow in the lives of many small mammals and the predators who feed on them. After a review of this literature, a prudent land manager would conclude that snowmobile traffic must be contained within certain areas and not be allowed a free run on the landscape.

INTRODUCTION

An off-road recreation vehicle (ORRV) is any motorized vehicle capable of travel on or over land, water, snow, ice, marsh, swampland, or other natural terrain without benefit of road or trail (U.S. Dept. Interior 1971). There are at least four different types of ORRV's: the 4-wheel-drive vehicle, the motorcycle, the snowmobile, and most recently, the all-terrain vehicle (ATV).

Significant production of ORRV's began in the midfifties (U.S. Dep. Interior 1971, Doyle 1973). Since then production of ORRV's has increased at a phenomenal rate. Motorcycle and snowmobile sales in the United States are two examples as seen in the following tabulations:

Year	*Motorcycles sold*
1955	20,000
1960	60,000
1970	1,430,000
[1]1980	1,700,000

Year	*Snowmobiles sold*
1960	<500
1963	10,000
1970	445,000
1973	530,000
[1]1976	576,000
[1]1979	1,000,000

[1] *Predicted.*

The rate of increase is predicted to drop significantly by 1980, since the current base of over 5 million ORRV's is so large (U.S. Dep. Interior 1971).

Because different types of ORRV's run on different kinds of surfaces (the ATV may be an exception), the distribution of ORRV's on the total landscape is patchy. Snowmobiles, for example, are restricted to the 31 snowbelt States, and even there distribution is anything but uniform. Of 1.2 million snowmobiles registered in 1972, 682,000 (56 percent) were in the States of Michigan, Minnesota, and Wisconsin.[2]

Because there are so many ORRV's in the United States, and because some types are concentrated in relatively small areas of the total landscape, there is ample reason to consider the impact of these vehicles on ecologic systems. There is also ample reason to consider possible conflicts between users and nonusers of ORRV's.

The Executive Branch of the Federal Government recognized that negative ecologic and sociologic impacts are inevitable with so many mechanized vehicles. In February 1972, President Nixon issued Executive Order #11644 "... to establish policies and provide for procedures that will ensure that the use of off-road vehicles on public lands will be con-

[2] *Statistics from Int. Snowmobile Ind. Assoc.*

trolled and directed so as to *protect the resources* of those lands...and to *minimize conflicts among the various uses of those lands*" (italics added).

ORRV's are not going to go away, and indeed they shouldn't for they have positive recreational values. However, something must be done to make ORRV use compatible with the environment desired for nonmechanized recreation. Legislation is only a partial solution for resolving conflicts between users and nonusers of ORRV's. In addition to sanctions or laws, what is needed is a sensitive approach by resource managers utilizing the science and skills of ecology, engineering, the landscape design arts, and the behavioral sciences.

The purpose of this paper is to review the body of environmental knowledge on one type of ORRV--the snowmobile--and to show by example how this information could best be used by resource managers now--without waiting for more definitive research to be done. This exercise should also prove instructive for managers concerned with other types of ORRV's.

While we are here dealing only with environmental impacts of ORRV's, we should recognize the importance of coming to grips with the behavior and experiential aspirations of ORRV users. Only when we know what users are seeking from their experiences can we begin to effectively control the way they use landscapes. The research necessary to generate this knowledge is now almost totally lacking. Hopefully, social scientists will soon be undertaking behavioral studies of ORRV users.

INFORMATION NEEDED

Resource managers are already aware that any substantial intrusion by man on a natural scene is disruptive. They know that physical compression of the surface affects the underlying soil, snow, plants, and animals. Whether man makes a beaten path by foot or on snowmobile, the surfaces transected will be affected in some negative way; these negative effects, known as *proximal* or *point* impacts, are often immediate and dramatic. Moreover, at some stage use may increase so drastically that the ecological insults become intolerable and the system begins to malfunction. These malfunctions are the *ultimate* or *system* effects that should primarily concern resource managers.

Point and *system* effects can be further illustrated by a field whose snow cover is compacted by intensive snowmobiling, an apparently common occurrence around metropolitan areas (fig. 1 in Schmid 1971). A point effect might be the decline in weight of vegetation the following growing season. A plausible consequence of the snow compaction and phytomass decline might be large-scale mortality of field rodents. Ultimately, the decline in rodents could reach up a food chain to affect raptorial birds who feed on field rodents, and thus affect an entire system. System effects would usually not be observable for some time, perhaps years, after the initial disturbance.

Man on foot, snowshoes, or touring skis could, however pure his intentions, cause similar disruption of a system. But snowmobiles have enabled him to do it at a much faster rate. Consider, for example, the area compacted by a ski tourer on 3-inch-wide skis traveling at 6 miles per hour for 10 hours compared with a snowmobile having a 30-inch-wide tread traveling at 20 miles per hour for 10 hours: the skier would compact 4 acres while the snowmobile was compacting 61 acres. Another comparative illustration is given by Pruitt (1971) who in a small but neat study found that the morphological and insulative characteristics of a snowfield had changed significantly after two passes with a snowmobile, while it took 50 passes by people on snowshoes to make an equivalent change in the snow (table 1).

It is the job of research to devise a theory which will give managers a basis for predicting where ecologic dysfunction is apt to appear. This is especially critical in this era of the ORRV when rates of impact are greatly accelerated over times when recreationists traveled the unroaded landscape on foot. Managers need predictions of ultimate or system effects. Knowledge of the result of point impacts may be crucial for systems scientists but will be of little practical value to managers.

Table 1.--*Snow-compaction effects (adapted from Pruitt 1971)*

Type of compaction	Thickness	Density	Hardness	Heat transmission
	Cm		Gr/Cm^2	$Cal/cm^2/sec/°C$
Undisturbed snow	33	0.14-0.20	4- 80	1.52×10^{-4}
One pass with snowmobile	14	0.26	3,000	2.49×10^{-4}
Two passes with snowmobile[a/]	23	0.36	7,000	6.4×10^{-4}
Fifty "people passes" on showshoes	15	0.39	2,500-4,000	6.4×10^{-4}

a/ After drifting.

AVAILABLE INFORMATION

The scientific literature on the impact of snowmobiles on life systems is limited; the first reports of original research did not appear until 1971 (Wanek 1971a). An intensive search revealed but 16 reports of original research (table 2) with some degree of scientific merit; that is, the authors used the scientific "method." Of the 16, seven were progress reports, five appeared in the proceedings of symposia, two appeared as abstracts, one appeared in a semipopular magazine, and only one appeared in a scientific journal.

While many of these studies were exceptionally well conceived and conducted, none was ecosystemic in scope. All were limited in terms of factors studied (table 2). A review of current studies of environmental impacts of snowmobiles promises few definitive reports in the near future.[3]

In summary, the literature answers a few questions about the effects of snowmobiles on parts of systems but none on total systems. I suspect the same would hold true as regards other types of ORRV's.

AN ALTERNATIVE

Even though we do not know the system effects of snowmobiles, it is possible to infer some of these effects from the ample existing literature on snow irrespective of snowmobiles--in Bergen 1971; Curl, Hardy, and Ellermeier 1972; Gold 1956; Kingery 1963; Mantis 1951; and Maykut 1969, to name a few.

We know that deep and fluffy snow (i.e., snow of low density) is a good insulator. For instance, in east central Minnesota the nocturnal air temperature 15 cm (6 inches) above the snow surface can be -41° C (-40° F), while under 44 cm (18 inches) of snow the ground surface is a constant -4° C (24° F) (Gullion 1967).

Moreover, the insulation that snow provides is very important to many small mammals (like mice and shrews) which spend most of the winter at the ground and snow interface. The Russian, A. N. Formozov (1946), called our attention to the importance of snow cover and more recent studies have confirmed it (Irving 1972; Pruitt 1957, 1970). For example, the varying lemming in the arctic, the longtail vole of western North America, and the widely distributed meadow vole are all subnivean (living beneath the snow surface). They have "lower critical temperatures" (the environmental temperature at which their heat production must increase above the basal level) ranging from 14° to 29° C (Scholander *et al.* 1950, Beck and Anthony 1971, Weigert 1961). Thus, it is reasonable to assume that mammals as small as these three species would suffer greatly if they could not find winter shelter under deep, fluffy snow. Beer (1961), in fact, did document an apparent die-off of small mammals (mainly the redback vole and the white-footed mouse) in southeastern Minnesota during a winter when there was no snow cover until mid-February.

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[3]*The author attended a "Snowmobile and Off-the-Road Vehicle Symposium" at Michigan State University in September 1973. Although the papers have yet to be published, the author believes the research is still not ecosystemic in scope.*

Table 2.--*Reports of research on the environmental impacts of snowmobiles*

Author(s)	Location of study	Factors studied
Anonymous 1972	SW & NW Wis.	Harvest yields of forages; changes in percent botanic composition; soil compaction
Bollinger and Rongstad 1972	SW Wis.	Noise propagation by snowmobiles; cottontail rabbit; white-tailed deer
Dorrance *et al.* 1973	E. Central & Central Minn.	White-tailed deer home range in relation to snowmobile traffic and vegetation
Huff *et al.* 1972	E. Central & Central Minn.	White-tailed deer
Huff and Savage 1972	E. Central Minn.	White-tailed deer; cover-type selection by deer
Jarvinen and Schmid 1971	SE Minn.	Small mammals in an old field
Lavigne 1973	W. Maine	Movements of white-tailed deer in yards
Marshall 1972	SE Minn.	Invertebrates in an old field
Neumann and Merriam 1972	SE Ontario	Characteristics of snow; woody vegetation; snowshoe hare; red fox
Schmid 1971, 1972	SE Minn.	Snow density and compaction in an old field; small mammals
Soom *et al.* 1972	SW Wis.	Noise propagation by snowmobiles; cottontail rabbit; white-tailed deer
Wanek 1971a	N. Central Minn.	Soil temperature; woody vegetation
Wanek 1971b	N. Central Minn.	Soil temperature, bacteria, and fungi; woody vegetation
Wanek 1972	N. Central Minn.	Soil temperature and bacteria; woody vegetation; harvest yields of forages
Whittaker and Wentworth 1971	NE Maine	Harvest yields of forages

Because mechanical compaction reduces snow depth, increases thermal conductivity and snow density by destroying air spaces (Jarvinen and Schmid 1971; Schmid 1971, 1972), we could infer a negative impact--in this case mortality in some small mammal populations--as a result of man-induced snow compaction. We could arrive at this conclusion without recourse to research reports on the snowmobile and its impact on small mammal populations.

In our example, we feel reasonably secure in extrapolating our conclusions to include the snowmobile. Schmid (1971), for example, has presented conclusive evidence that heavy use of fields by snowmobiles will increase snow density to values between 0.45 and 0.49 g/cm^3 (the maximal or critical density of snow is about 0.59 g/cm^3 (Maykut 1969)). Schmid concluded that "these densities are so high that it is doubtful if any movement of small mammals could occur at the snow-ground surface." In addition, Jarvinen and Schmid (1971) and Schmid (1972) gave preliminary but reasonably conclusive evidence that populations of subnivean mammals in fields

compacted by snowmobiles dropped to a point approaching extinction.

We might go further than our conclusion that compaction of subnivean habitats by snowmobiles could cause significant mortality in populations of small mammals. It is well documented that certain raptors, especially the hawks and owls, rely heavily on small mammals as a food source during winter and early spring. In a study in southern Michigan, meadow and white-footed mice comprised 91 percent of the winter food of great horned owls, and small mammals in general (mice, rats, shrews) formed 99 percent of the red-tailed hawk's diet (Craighead and Craighead 1956). Because these raptors lay eggs in late winter and early spring (the great horned owl, for instance, may be incubating its clutch in early February) and see them hatch during March or April, it is critically important for them to have an adequate food supply during that period. While I have not found documentation of the effect of a die-off of small mammals, such as Beer (1961) reported, on the productivity of raptors, it seems reasonable to conclude that their productivity would suffer significantly.

A prudent natural resource manager might accept these documented bits of evidence, since the underlying assumptions appear solidly based on biological and physical principles, and conclude that compaction of a large area by snowmobiles would significantly affect food chains which end in raptors. If he were willing to be slightly less prudent, he might go further and conclude that negative feedback would eventually occur and the "balance" between prey and their predators would be irreparably altered.

Similar arguments might be developed for events more subtle than mechanical compaction of snow and subsequent food chain effects. The northern bald eagle, for instance, begins its courtship and nesting in late February and early March. Some eagles--perhaps the majority of eagles--are extremely sensitive to human intruders and may abandon their reproductive efforts when disturbed. Although this event has not been conclusively documented, conservative resource management would direct snowmobiles and other recreational activities away from eagle territories.

SUMMARY

ORRV's are seemingly here to stay. Without question, they cause negative impacts on ecologic systems, but, then, so do other types of recreation, as well as agriculture, roadbuilding, urbanization, etc. Because ORRV's are much faster than man on foot they greatly accelerate the rate of environmental degradation.

This is akin to the phenomenon termed "future shock" (Toffler 1970); that is, the future (in this case, the time it takes to arrive at intolerable levels of environmental degradation) is arriving at a much faster rate than ever before. It should not be surprising that the manager's reaction time must decrease over what it was in the past.

Resource managers should be concerned with landscapes and ecosystems rather than with point impacts or small pieces of the landscape. Unfortunately, the impact of ORRV's on ecosystems will probably not be well documented for some years.

Nevertheless, there is an extensive separate literature on snow which should allow for some "best guesses," at least for impacts by snowmobiles. We can seriously question the contention of a recreation land manager in Minnesota who stated, "...the so-called ecological impact of snowmobiles has been very much exaggerated...with over 30,000 hours of fieldwork during the past 6 years and not one damage case reported of any significance, we doubt that there is a snowmobile problem" (Shuldiner 1973).

We know that when significant areas of landscapes are repeatedly traversed by ORRV's there is a good *chance* of serious dysfunction in the ecosystem. Of course, the level of chance that a manager is willing to accept is also influenced by social and political factors. I believe "systems safe" patterns for ORRV traffic could now be designed using available information on ecologic functions and processes. One way would be to restrict traffic to a few existing roads and trails.

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RECREATION AND/OR NATURE PRESERVATION

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ABSTRACT.--Numerous objectives have been given for nature reserves, from the preservation of organisms and ecosystems for their intrinsic and scientific values to providing areas for public education and recreation. In response, society has devised several types of preservation areas, ranging from strict nature reserves where recreation is excluded or severely constrained to Wilderness Areas and natural parks where public recreation and education are important goals. In recent years there has been a tendency to equate ecosystem preservation with Wilderness or with strict nature reserves. But, in fact, it is possible to preserve ecosystems within a range of facilities for public use. Size constrains such development more than the kinds of facilities themselves. It is essential that facilities be compatible with both objectives and size. Consumptive use of natural resources and certain heavy-impact recreational uses (such as all-terrain vehicular travel) must be excluded from all types of nature reserves. Active preservation programs are often needed to restore or maintain vital ecosystem processes where man has altered the system. Restoration of fire or missing predators are examples. For areas where both recreation and preservation are objectives, educational and interpretive programs can make these uses more compatible.

INTRODUCTION

The debates between advocates of "multiple use" and the "preservationists" have been increasing throughout the United States and Canada in the last 20 years. Much of the discussion centers around the allocation of wildlands for commodity production (timber, minerals, grazing, etc.) as opposed to ecosystem preservation. But another theme is also being heard with increasing frequency and intensity. Is recreational use of nature preservation areas, in fact, compatible with preservation? It is this question I want to explore here. I ask you to take a careful look at the actual degree of compatibility between recreation and preservation as land uses and human activities.

I speak to you as a confessed preservationist, as an avid wildlands recreation user, and as an ecologist who has tried to come to grips with certain very real technical problems in nature preservation programs. I hope this perspective will stimulate useful dialogue. The questions I want to help us address are these:

(1) What public objectives can be served by nature reserves of various kinds, including both those where recreation is traditionally allowed, and those where it is not?

(2) What kinds of nature reserves and related preservation-oriented areas do we have, at present, both where recreational use is allowed, and where it is prohibited?

(3) Are wilderness and preservation synonymous?

(4) What is the effect of size on the compatibility of recreation and preservation?

(5) What kinds of recreational use are compatible with preservation, and where can such uses be best accommodated?

(6) Can we identify needs for educational and interpretive programs to increase the compatibility of recreational use in appropriate preservation areas, and to achieve stated public objectives?

My questions indicate that I see no absolute dichotomy between recreation and preservation. And if we take a reasoned look at the public needs to be served, I think we can identify both the situations that call for separation of uses and those that require specified kinds and levels of recreational use. There is really a continuum of possible objectives and uses. Once this is perceived, I

think the necessary management direction becomes much clearer.

PUBLIC OBJECTIVES TO BE SERVED

A wide spectrum of possible public objectives has been asserted for various types of nature reserves, parks, wilderness areas, and related special areas where nature preservation is at least a partial goal (Bormann 1966, Brower 1960, Darling and Eichhorn 1967, Dasmann 1973, Falls 1967, Franklin and Trappe 1968, Franklin *et al.* 1972, Heinselman 1965, 1973, Lindsey *et al* 1969, Littlejohn and Pimlott 1971).

The following list includes most of the ideas usually given:

1. Preservation of unique, rare, or endangered species, natural communities, or ecosystems, simply to prevent their elimination and to maintain the natural diversity of the earth's life system.

2. Providing areas for the scientific study of organisms, plant and animal communities, and their environments in natural systems.

3. Providing gene pools of the native plant and animal species whose genetic stocks have not been manipulated by man.

4. Providing check areas for scientific comparisons with the technologically modified ecosystems of the man-dominated general landscape.

5. Providing areas for the scientific study of large-scale natural ecosystem processes of the kinds detectable only in relatively complete examples of a biotic province. Such areas must be large enough to contain the full range of plant and animal communities characteristic of a physiographic region.

6. Providing areas for use in formal education at all levels from grade school through university graduate programs, including areas suitable for short field trips, extended learning experiences, and outdoor laboratories for graduate research.

7. Providing areas for the education of the general public in understanding natural environments and the ecological problems facing mankind.

8. Providing areas for the aesthetic and psychological appreciation of bona-fide natural ecosystems by the public.

9. Providing areas where the public can experience and appreciate the historical background of our civilization by witnessing actual historical settings in their natural state, and by reliving pioneering experiences in a real-life setting.

10. Providing areas where the public can participate in primitive and unconfined types of outdoor recreation in a natural setting away from the sights and sounds of civilization.

Note that this list is more or less ordered with science-related objectives first and public participation objectives second. The latter group is also ordered with the educational and intellectual objectives first and the strictly outdoor recreation objectives last. Now let's look at the kinds of areas our society has devised to meet these objectives.

KINDS OF RECREATION AND/OR PRESERVATION AREAS

I see five broad classes of preservation areas, each emphasizing a somewhat different combination of the above objectives. There is actually a continuum of objectives and use policies here, but this list should help us see how society is responding to the needs people express:

1. Strict nature reserves
2. Major natural parks and related reserves
3. Wilderness Areas
4. Lesser natural parks and related reserves
5. Special areas.

I intend to include in these classes only those areas or portions of areas where the commercial use of the area's natural resources is prohibited, and where some stated or implicit preservation policy exists. For example, only the present interior zone of the Boundary Waters Canoe Area (about half of the area) actually has a preservation policy, and only the Wilderness Sanctuary of Itasca State Park in Minnesota has a strict policy. The actual ecosystem preservation program may be passive or

active. In many cases it is still only passive (more on this later). I should also observe that there would really be some "double counting" if one were to total up the acreages now committed to each of these classes. For we have *strict nature reserves* within *major natural parks* and *Wilderness Areas*, *Wilderness Areas* within *major natural parks*, and so on.

The distinctions between my five classes need sharpening. Let me do this by listing the following for each: (1) typical names attached to the class, (2) typical ownership patterns, (3) typical size, (4) typical use policies, and (5) some "real world" examples from our region.

Strict Nature Reserves

(1) Typical names: research natural areas, natural areas, scientific areas, natural history areas, (a confusing name: wilderness sanctuary).

(2) Typical ownership: Federal, State departments of natural resources, universities and colleges (public and private), The Nature Conservancy (private).

(3) Typical size: 20 to 1,000 acres (over 640 preferred).

(4) Typical use policies: research and education are the dominant intended uses; also may serve as gene pools if large enough and well buffered. Many areas have hiking trails for access--often open to the public for nature appreciation walks. Camping, picnicking, hunting, fishing often prohibited. Use of all motor vehicles and ATV's (all-terrain vehicles) generally prohibited except for necessary research or educational purposes, or on public roads which may exist for access. Structures such as field laboratories and research installations sometimes present. May be fenced and/or posted against public use.

(5) Examples: Cedar Creek Natural History Area, University of Minnesota; Cyrus H. McCormick Experimental Forest, Research Natural Area, North Central Forest Experiment Station, U.S. Forest Service; Passage Island Natural Area, Isle Royale National Park; Helen Allison Savanna, The Nature Conservancy, Minnesota.

Major Natural Parks and Related Reserves

(1) Typical names: National Parks, State parks, Provincial parks.

(2) Typical ownership: Federal, State, Provincial.

(3) Typical size: 5,000 to 500,000 acres (in our region).

(4) Typical use policies: camping, hiking, backpacking, canoe-tripping, boating, cross-country skiing, snowshoeing usually encouraged. Fishing permitted. Hunting usually prohibited. Nature appreciation often encouraged through interpretive programs. Educational and scientific uses encouraged. Serve as major gene pools. Snowmobiles and outboard motors may or may not be allowed. ATV's prohibited except on some roads. Auto roads may or may not be present, depending on nature of the park's resources and development policies. Auto campgrounds, roadside picnic areas, latrines, administrative structures, and public service facilities often present (may be operated by concessionaires). Back-country campsites often constructed, may include simple trail shelters. Developments typically in enclaves, with large expanses of undeveloped natural ecosystem areas separating developed sites. May contain designated *Wilderness Areas* or *strict nature reserves*.

(5) Examples: Isle Royale National Park, Michigan; Quetico Provincial Park, Ontario; Porcupine Mountains State Park, Michigan.

Wilderness Areas

(1) Typical names: wilderness area, canoe area, or (portions of) wildlife refuges.

(2) Typical ownerships: Federal, State, Provincial.

(3) Typical size: by law, over 3,000 acres in Michigan, and generally over 5,000 acres for areas designated under the U.S. Wilderness Act of 1964. There

are exceptions to these minimum area guides, but in practice most areas exceed 10,000 acres. The actual maximum size of individual units now present in the north central region that fit the concept is about 500,000 acres.

(4) Typical use policies: backpacking, hiking, canoe-tripping, cross-country skiing, snowshoeing, nature study encouraged. Fishing permitted. Hunting may or may not be allowed. Educational and scientific uses encouraged. Serve as major gene pools. Outboard motors and snowmobiles normally prohibited but in our region there are exceptions. Landing of aircraft, use of automobiles and ATV's normally prohibited. All vehicular roads normally excluded. Hiking trails, portages, and simple permanent campsite facilities often provided. Essentially no permanent structures permitted (administrative cabins sometimes are an exception--most are being phased-out). Differ from *major natural parks* chiefly in prohibition of all roads and mechanized travel and all kinds of structures. May in fact be a designated portion of a *major natural park*; may contain *strict nature reserves*.

(5) Examples: most of Isle Royale National Park, Michigan; much of Quetico Provincial Park, Ontario; much of the interior zone and some of the portal zone of the Boundary Waters Canoe Area, Minnesota, and just designated, most of Porcupine Mountains State Park, Michigan.

Lesser Natural Parks and Related Reserves

(1) Typical names: State parks, county parks, city parks, wildlife refuges.

(2) Typical ownership: State, county, municipal, sometimes Federal.

(3) Typical size: 20 to 5,000 acres.

(4) Typical use policies: day hiking, camping, boating, cross-country skiing, snowshoeing, and nature study usually encouraged. Picnicking and fishing usually permitted. Hunting usually prohibited. Outboard motors often allowed. Snowmobiles and ATV's often prohibited, except on roadways. Auto campgrounds, picnic areas, and back-country campsites often constructed. Public roads often present. Administrative structures, latrines, and public service facilities often present. Scientific and educational values may not be emphasized, but may exist. Could serve as gene pools if large enough and well buffered.

(5) Examples: some sections of Itasca State Park, Minnesota (beyond the Wilderness Sanctuary); Nerstrand Woods State Park, Minnesota.

Special Areas

(1) Typical names: ecological areas, botanical zones, botanical areas, geological areas, Wild Rivers, etc.

(2) Typical ownership: Federal, Provincial, State, private.

(3) Typical size: 5 to 5,000 acres.

(4) Typical use policies: extremely variable. The only thing in common here is the temporary or permanent exclusion of commercial uses of the natural resources. Many such areas are either too small to fit the other categories, or their policies are in limbo for various reasons. Many are really unofficial examples of one of the first four classes above.

(5) Examples: LaRue-Pine Hills Ecological Area, Shawnee National Forest, Illinois; The Botanical Zone, Sylvania Recreation Area, Ottawa National Forest, Michigan.

WILDERNESS AND PRESERVATION NOT SYNONYMOUS

There has been a tendency in recent years for the public and even some professionals to equate the term "wilderness" with "preservation" of nature. This has undoubtedly occurred because of the great social pressures and debates over the need for more formal *Wilderness Areas* in the sense I used this term above. But the original term, as applied by Aldo Leopold, Robert Marshall, Howard Zahniser, Olaus Murie, Sigurd Olson, and others, was used in the sense I have used it above. It would be wise for agencies and the public not to apply the term to very small areas, or to areas where certain kinds of public use developments are allowed.

An area does not have to be free of all roads, auto campgrounds, public service facilities, and so on, to be dedicated largely to the preservation of nature. These kinds of development often bring pressures for incompatible uses, and may make preservation more difficult, but they do not *of themselves* preclude preservation of the flora and fauna beyond the areas directly impacted, and a reasonable buffer zone. Extensive discussions of this problem appear in Darling and Eichhorn (1967), and in the Conservation Foundation's recent report (1972). The problem is in achieving the stated public objectives for preservation of the natural ecosystem while at the same time providing easy public access to permit as many people as possible to experience that ecosystem. It can be done, but the management techniques required are very different from those permissible in *Wilderness Areas*.

EFFECT OF SIZE ON COMPATIBILITY OF RECREATION AND PRESERVATION

The larger an area the more recreational use it can absorb without seriously compromising nature preservation objectives. Yellowstone National Park is a clear example. In spite of hundreds of miles of auto roads, dozens of large campgrounds, hotels, motels, and service facilities, most of the park remains a pristine wilderness that fits the most exacting criteria for *Wilderness Areas*. If you doubt this, I suggest you put on a pack and take to the trails! The ecosystems of the back country are little affected by the heavy use along roads. I am not suggesting that the automobile-oriented developments and heavy traffic are desirable, but I think these facts make a point about area size. If these same developments were imposed on a 20,000-acre park instead of a 2-million-acre one, the area's natural environment would be virtually eliminated just by the developments themselves.

The Boundary Waters Canoe Area is another example. There are more than 2,000 wilderness campsites on remote lakes in this area. Many of them have a steel fireplace grate, a simple box-style latrine, and (some) even tables. Many have been heavily used since the voyageur's era. But these campsites have an average impact area of less than one-half acre each. The total area directly impacted by such sites is therefore less than 1,000 acres. In a 1-million-acre Wilderness this is less than one-tenth of 1 percent of the area. Including portages and trails in addition, I doubt that visitors to the BWCA directly impact more than one-half of 1 percent of the area. Because of the nature of the terrain, the density of the vegetation, the fact that most travel occurs on lakes and streams, and the great size of the area, the visitors are really no threat to the natural vegetation of the area except on the campsites themselves. One can and should view these campsites as small developed sites that are necessary to achieve important public objectives for the area. There may be too many visitors with respect to the psychological experience of wilderness, and too much noise and conflict with motors and snowmobiles for the same reason. But it is simply not true that a significant proportion of the land ecosystems of the BWCA are being substantially damaged by the visitors. The campsites are "windows to the Wilderness" that serve an important function. Rotating campsites will damage more ecosystem area than simply hardening the sites that are well situated, and accepting some loss of their natural character.

But the converse of these examples poses a very different problem. If one attempts to preserve nature on very small tracts, then very little--or only very tightly controlled use--can be tolerated, or the natural environment could literally be trampled to death. At most, limited trail development, with "keep on the trails" signs are required. Campsites and picnic areas are clearly incompatible. I am thinking here of areas in the 5- to 200-acre size range. Very good judgment is necessary to set the permissible levels of use and development for intermediate-size areas.

WHAT RECREATIONAL USES ARE COMPATIBLE WITH ECOSYSTEM PRESERVATION?

It should be clear from my listings of possible objectives and classes of areas that there is no clear answer to

this question. It depends largely on the objectives, size, and ecosystem characteristics of the specific area. If the focus is largely on scientific and educational values and especially if the area is small, then few recreational uses are appropriate. For such areas, only hiking trails seem permissible, and in some cases even these should be excluded. Camping and picnicking are inappropriate in such areas.

But if the objectives include the aesthetic appreciation of nature, the ecological education of the general public, and the physical experiences of travel and living in a natural environment, then public use is necessary to achieve these objectives. Again, if the area is large, it is quite easy to provide for hiking, backpacking, canoeing, tent camping, cross-country skiing, snowshoeing, and other light-impact uses that get the public into the ecosystem where these objectives can be realized. If very easy access is desired to make the area available to the very young, the elderly, and those without the inclination (or the time) to participate in such physical activities, then auto access or public conveyances are required. Auto campgrounds could still be excluded if desired.

Certain uses seem clearly incompatible, or at best marginal, in any kind of nature reserve. Among the clearly incompatible I would put the use of ATV's and snowmobiles off designated roads or trails. They probably should be prohibited in all such areas, except on auto roads as a substitute for an automobile. The nature of these vehicles makes their control difficult. Perhaps the only effective way of protecting the off-trail areas is prohibiting the use of such vehicles entirely. Outboard motors are clearly incompatible where the experience of solitude in a natural setting is an objective.

Hunting is a marginal use at best. I happen to be a lifelong and still avid hunter myself, but in most areas hunting is incompatible with preservation objectives because it substitutes the gun for natural mortality factors. The case for carefully controlled hunting in large *Wilderness Areas* is debatable. Such use is permitted in National Forest Wilderness. I suspect the day will come when that, too, must be prohibited. For example, the (illegal) killing of wolves is a common practice in the remote areas of the Superior National Forest, including parts of the BWCA, even though wolves are an endangered species that exists nowhere else in the "lower 48." The reintroduction of woodland caribou into the BWCA is a very real technical possibility, but I wonder if they would stand a chance while deer hunting is permitted? Where key native predators are missing from the ecosystem it may be necessary to control some herbivores with the gun, or by other means.

Ordinary fishing, with the emphasis on taking home a large catch, also seems a questionable use. Fishing for fun only, or only for actual consumption while using the area, seems much more acceptable. We should be as concerned about aquatic ecosystems as land ecosystems.

THE NEED FOR ACTIVE ECOSYSTEM PRESERVATION PROGRAMS

Preservation does not mean that an ecosystem can be put in cold storage! One of my favorite themes is that the natural ecosystems of North America were extremely dynamic. There was constant change. And often these changes were triggered by perturbations of the system by powerful forces such as fires, windstorms, or severe insect epidemics. These things are natural and should not, indeed, probably cannot, be excluded from nature reserves. We must soon revise our management plans and strategies for all kinds of preservation areas, or we will fail to attain their most important objective--the actual maintenance or restoration of the natural ecosystem. All other objectives hinge on the achievement of this one, but this is the one aspect of our programs we often assume will "take care of itself." It won't! (Leopold *et al.* 1963, Heinselman 1970a).

We must stop "cleaning up" blowdowns. And we should not interfere with epidemics of native insects. If fire was part of the natural system, we must try to reintroduce it safely by prescribed, controlled burning if necessary (Heinselman 1971, 1973). If important native wildlife species are missing, but not extinct, we should consider their reintroduction. Predator control and the disruption of population balances by hunting or trapping should be dealt with if they are factors.

In connection with prescribed burning, let me point out one potential prob-

lem that may be avoided by looking ahead. If new structures and service facilities are planned for a fire-dependent ecosystem, we should put them where protection from the necessary fires will be easy. Large expanses without natural firebreaks and within continuous fuel types are obviously poor places.

NEEDS FOR EDUCATIONAL AND INTERPRETIVE PROGRAMS

The compatibility of recreation and preservation objectives for many areas could be increased by two kinds of information programs:

(1) Educational programs for the general public to help people understand different preservation areas and their appropriate uses.

If people knew in advance of their visits what an area had to offer, what its resource characteristics were, and what the appropriate and inappropriate activities were, most would only visit areas that suited their tastes and trip objectives. This would divert much use that now occurs because people have no real understanding of the public purposts to which given areas are supposed to be devoted.

(2) Interpretive programs to enhance visitor appreciation of the natural ecosystem values of specific areas.

The U.S. National Park Services does a pretty good job in this area, but many fine nature reserves have little or no interpretive literature, and no onsite or nearby interpretive programs. Nature reserves of many kinds can serve vital public needs. But this does not happen automatically. There must be appropriate literature, good maps, films, slide-tape programs, exhibits, self-guided tours, lectures, and other useful aids to understanding the ecosystem and planning a pleasant and rewarding visit. Without these aids, most of us see far less than is really there.

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APPROACHES TO FORECASTING RECREATION CONSUMPTION

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ABSTRACT.--This paper summarizes approaches to forecasting consumption of resource-based outdoor recreation. Although the discussion is oriented toward the quantity of recreation that will be consumed, qualitative aspects of recreation experiences and environments are also discussed. Forecasting models are evaluated in terms of suitability for recreation planning and accuracy of results.

RECREATION CONSUMPTION MODELS IN GENERAL

Why Forecast Recreation Consumption?

With growing competition for all forest land resources, decisionmakers are searching for information on which to base present and future resource decisions. Demands on all resources must be anticipated so that current management programs can be adjusted to meet changing needs. Accurate recreation use forecasts are needed to determine what kinds and amounts of recreation facilities are required, as well as how they should be distributed. Such forecasts provide a basis for facility investment decisions and serve as an input to policy formulation. Recreation use forecasts also provide a mechanism with which to evaluate long-term implications of alternative management decisions.

Problems in Forecasting

Any forecasting model must necessarily reflect uncertainty about future economic, social, and political circumstances. Models developed to forecast recreation consumption may reflect more uncertainty than most. One major problem in developing such models is the lack of useful input data. Such data are difficult and expensive to collect. Compromise is often necessary between the cost of data collection and the accuracy of data obtained. Secondary data sources--the U.S. Population Census, Bureau of Outdoor Recreation, or past surveys are usually relied upon. Such data are often imprecise and difficult to incorporate into comprehensive models for regional or local planning.

A major problem in constructing models to forecast recreation use is that the elements that determine recreation behavior are poorly understood. The human motivational factors that underlie recreation behavior are complex and are just now starting to receive research attention. Additional research is needed to determine the ways in which various recreation activities provide outlets for satisfying human needs. While participation in most recreation activities is increasing, activities that are inexpensive, provide a desirable "image," allow the participant the opportunity to demonstrate a skill, and use leisure time efficiently are likely to grow at a faster rate in the future.

Most recreation use forecasts assume a constant relationship between consumption and the quality of the recreation experience received. Yet it can be argued that the quantity of recreation consumed and the quality of experience received are at least partially substitutable. Actual consumption can be increased, but the total enjoyment received may actually decrease.

The nature of the recreation "product" also makes forecasting difficult. Recreation planners are most often concerned with a group of activities that make up the total recreation experience or pack-

age. Should models be developed to predict only camping use, or camping use and other activities related to the camping experience? The product, recreation, is not marketable as a unique package, but enjoys a wide range of substitutability in terms of what is placed in the "package."

Restrictive assumptions are often necessary to develop recreation use forecasts. The relationship between future demand and recreation supply is often assumed to remain constant. Management and policy decisions that affect recreation consumption are often assumed to be unchanging, as are other factors that underlie recreation behavior. The impact consumption is seldom incorporated into forecasts. Such assumptions often lead to completely foolish projections, i.e., each individual midwestern resident would spend 1,500 days per year boating on TVA reservoirs, or that people would spend their entire lifetimes camping!

A further problem involves the decision of what to predict. Is estimated total annual recreation consumption a useful measurement? Should peak use be forecasted in user-days or in visitor-days? Or should "use" be defined in terms of total participant satisfaction received--a measure that is not necessarily correlated with actual use? The USDA Forest Service uses visitor-days as a measure of use. New York State uses the recreation consumption on the fifth highest-use summer Sunday afternoon. Other agencies use other measures.

Another problem involved in developing accurate forecasting models is that the recreation experience itself is hard to identify. Clawson and Knetsch (1966, p. 34-36) have argued that the outdoor recreation experience can be broken down into five major parts: anticipation, travel to the site, the onsite experience, travel from the site, and experience recollection. Each of these facets of the recreation experience has an influence on consumption, yet most current forecasting models are concerned only with the onsite experience.

Because of the difficulties mentioned above, it is no wonder that predicting recreation consumption has been referred to as "the Achilles heel" of recreation planners and managers (Chubb 1967). Yet imaginative approaches, that attempt to incorporate recreation supply variables, user behavior, management procedures, technological change, and qualitative values, have been taken to overcome the problems inherent in recreation consumption forecasting. These will be discussed later in this paper.

Recreation Demand and Consumption

The outdoor recreation literature contains abundant references that draw a clear distinction between recreation demand and recreation consumption (Chubb 1967, Clawson 1959, and Knetsch 1970). Yet the two terms are often used synonymously. Demand refers to the quantity or units of a good or service purchased at specific levels of price. The economist defines demand as a schedule of prices people will pay for various amounts of goods and services. Clawson and Knetsch (1966) have developed an approach to evaluating recreation demand based on travel and other costs associated with the purchase of a day's recreation. Here, demand has a distinct meaning. Yet, we often read about recreation "demand" that is not really demand at all, but recreation "consumption"--i.e., total seasonal, weekly, or daily attendance in visitor-days, user-days, or some other appropriate measurement unit.

Consumption actually refers to the amount of recreation consumed at the existing level of price and facility supply. Consumption measures do not separate demand and supply conceptually. As Clawson and Knetsch (1966, p. 116) point out,

> "...attendance or use figures are the net effect of the existing demand and the existing supply, and should be so recognized. Improper accounting of supply considerations leads to the assumption that people will demand increasing quantities of what they now have, and can perpetuate present imbalances."

In this paper, recreation "consumption" is defined as the amount of recreation consumed at a specific level of recreation supply and price.

General Characteristics of Predictive Models

A model is simply an abstraction of the real physical world, incorporating the elements that are relevant to a particular process. Some models are intuitive and simple. Others, such as models used to forecast recreation behavior, are very complex and require mathematical abstraction. Development of models to forecast recreation use includes the search for relevant elements that influence recreation behavior, and structuring the relationship between these elements.

Although many variations of recreation consumption models have been developed, most mathematical models take the general form:

$$y = f(X)$$

Where: y = the predicted amount of a particular recreation activity consumed in visitor-days, use-days, etc., at a specified time in the future.

X = A set of user population characteristics, supply availability and accessibility, and qualitative aspects of recreation experiences and environments.

The symbol of $f(X)$ is a notation meaning "a function of X."

Wide variations exist within the above generalized model. Some recreation consumption models are developed for local predictions, some for regional, and some for national predictions. Some incorporate supply features exclusively, some include user characteristics, and some use both.

Regardless of the particular model, a basic assumption in most empirical approaches to forecasting recreation use is that the underlying structure of the model--the basic elements that determine behavior--is invariable in the long run. Models implicitly assume that processes that will govern recreation behavior in the future will be the same as those acting today (Cicchetti *et al.* 1969, p. 201). Most models also implicitly assume a constant interrelationship between demand and recreation facility supply over time.

The "Best" Approach

The ideal model for forecasting recreation consumption would provide the decisionmaker with an exact prediction of the amount and type of recreation use an area is likely to receive at a particular level of facility development and price. The ideal method should be dynamic so that changes in management policy, recreation supply, price, etc., can be incorporated into the model to determine their potential impact on predicted consumption. It should thus provide a framework for management decisions and reflect the consumer decision processes that underlie recreation behavior. The "best" model would have no error.

The ideal method should be flexible so that it can be applied to local, regional, and national planning needs as well as to various kinds of recreation activities or groups of activities. From a practical standpoint, it should be easy to understand, have minimum data input requirements, and require a minimum of personal judgment. It should provide consumption estimates that are related to facility supply decisions and to appropriate planning time horizons. Chubb (1967) would add that destination and origin zones used in modeling recreation consumption should be small enough to provide realistic planning guidelines. To serve as a basis for policy decisions, forecasts should quantitatively relate demand to supply in the same units of measure.

APPROACHES TO FORECASTING RECREATION CONSUMPTION[1]

Local, Regional and National Models

Extension of Past Trends

Extension of past recreation use trends has been widely used as a method for forecasting use on a local, regional, or national basis. The advantage of the technique is that it is simple to apply and provides reasonably accurate use estimates for short time periods, perhaps up to 5 years. It is most useful where the geographic area serviced by a particular recreation complex has a relatively stable population, and where rec-

[1] *For additional information on approaches to forecasting recreation consumption, see Clawson and Knetsch (1966, Chapter 7) and Shafer and Moeller (1971).*

reation supply and management systems have been stable. It is also useful where per capita recreation consumption has been relatively stable.

The application of trend extension for long-run forecasts is restricted by the many simplifying assumptions on which the method is based. First, it relies heavily on a past data series. In many instances, data have not been collected over a long enough period to provide a reliable trend determination. Even where data are available, nonlinear, long-run trend extensions are subject to considerable error.

The trend extension method assumes that the forces that underlie recreation consumption, including facility supply, population needs, and related causal factors, will remain unchanged in the future. The method, therefore, is not based on causality. It assumes that factors that have operated to create recreation consumption in the past will continue to operate in the same way in the future.

The method is not reliable where the composition or "mix" of recreation facilities provided has changed or where new forms of recreation activities are emerging. An excellent example of inappropriate application of trend extension is provided by Clawson and Knetsch (1966, p. 120). They point out that from 1950 to 1960, construction of reservoirs by the Corps of Engineers coupled with technological advances in boat construction combined to produce a tremendous surge in boating activity. They demonstrate that simple extension of the 10-year trend would indicate that, by the year 2000, every citizen would boat on a Corps of Engineer reservoir approximately 2,500 times per year!

Informed Judgment

Quantitative models cannot incorporate special insight and the informed judgment of those directly involved with management of a given recreation complex. People who know the history of a particular planning unit, who have observed changing recreation use patterns, who understand resource capabilities, and who can subjectively evaluate the regional political-social atmosphere that is likely to prevail at some future date can contribute a great deal to making use estimates for a particular area.

Recreation use estimates derived from quantitative models can be tempered by informed judgment and special insight. Informed judgement can be used to incorporate into the forecasting process regional changes that are likely to occur and can identify realistic limits to sustained recreation resource capacity.

If relied upon too heavily, of course, informed judgment can create special problems. Individual biases can easily enter into the process and past short-term use trends can be misinterpreted. There is evidence to suggest that resource managers are not always able to perceive consumer interests correctly (Hendee and Harris 1969). Furthermore, rapid turnover in management personnel can create situations where reliable informed judgment is not available.

Informed judgment by itself is not a reliable approach to forecasting recreation consumption. But quantitative models should be developed that can take advantage of informed judgment whenever possible.

Extension of Trends in Basic Causal Factors

Gross estimates of future outdoor recreation consumption have often been developed using major causal factors that are thought to underlie recreation consumption. This approach bases forecasts on factors that have accompanied past growth in recreation consumption; e.g., population growth, increases in leisure time, increased mobility, and increased disposable per capita income. Projected trends in these basic factors are related to future recreation consumption.

This approach has some merit in making short-term forecasts (Clawson and Knetsch 1966). However, a major limitation is that many time-related variables are correlated to past growth in recreation consumption. The simple variable "time in years" provides a fairly high predictability base for past recreation consumption. Simply because a variable (e.g., mobility) has correlated with recreation consumption in the past does not mean that it will correlate with it in the future. The approach optimistically assumes that the factors that underlie current recreation behavior are known, and that the relationship between selected

"causal" factors and recreation consumption will remain unchanged in the future.

Like other similar forecasting methods, these projections are subject to gross error. Models that are based on several causal factors do not normally account for the independent effects of each causal factor by itself. The approach does not incorporate behavioral changes caused by shifts in individual interests, goals, or the relative availability of recreation substitutes. These behavioral relationships are assumed to remain constant into the future.

Population Characteristics and Recreation Consumption

The method based on projection of basic causal factors has been extended to models that more precisely relate consumption of a particular recreation activity to characteristics of people who currently participate in that activity. Consumer characteristics are then projected to some desired future year, and an estimate of probable future participation is calculated.

The approach is flexible. It can be applied to many types of recreation planning situations and to different recreation activities. It is also dynamic because it attempts to consider simultaneously many factors that underlie the recreation consumption process. Selected components of the predictive models can be changed to reflect different assumptions about future conditions. Changes in recreation supply characteristics can also be incorporated into such models.

The basic model is:

$y = f$ (socioeconomic and other user characteristics, distances, attractiveness of supply, and recreation substitutes available.)

Where y is some measure of recreation consumption.

Many different recreation consumption models have been developed that include selected predictor variables. Models have been developed for local, regional, and national application to various kinds of activities and recreation outings. The functional mathematical model--regression--remains the same, however.

Much of the data used to develop regression models has been collected through national recreation surveys conducted by the Outdoor Recreation Resources Review Commission or later surveys sponsored by the USDI Bureau of Outdoor Recreation.

Using 1960 and 1965 National Recreation Survey data, Kalter and Gosse (1969) developed recreation participation functions for residents of 12 planning regions in New York State. They used 13 regional socioeconomic population characteristics to construct models to predict three kinds of recreation excursions--total overall participation, vacation trips, and day outings--for five recreation activities. The models showed low predictability when compared to actual survey data. Also using National Recreation Survey data, Mueller and Gurin (1962) constructed a recreation activity scale that reflected participation in 11 outdoor recreation activities throughout the United States. They used socioeconomic characteristics to explain behavior.

Gillespie and Brewer (1969) used data collected through household surveys within the St. Louis metropolitan area to construct models that explained the number of water-oriented outdoor recreation activity days participated in per family. Seventeen socioeconomic variables were incorporated in their equations. Resulting models mathematically accounted for 62 percent of the variation in total annual water-oriented recreation activity for the sample group. Compared to other models, their model was relatively successful. Similar results may be obtained in other studies that are conducted within a fairly homogeneous region, where recreation supply is relatively fixed, and the recreation experience can be clearly defined.

Cicchetti *et al.* (1969) added considerably to the methodological framework of forecasting recreation consumption. They include both socioeconomic population characteristics and supply factors in their model. The general form of the model is:

$y_{it} = f$ (distance at $t - 1$) $+ f$ (quality and quantity at $t - 1$) $+ f$ (socioeconomic characteristics at t)

where y_{it} = expected quantity of a particular type of outdoor recreation consumed by the i^{th} individual in time period t (current time period).

Distance at $t - 1$ = the physical distance between the location of the i^{th} individual and recreation facility in period $t - 1$.

Quality and quantity at $t - 1$ = measures to reflect the relative availability of recreation facilities in period $t - 1$. Quality was measured by an index of crowding; quantity was indicated by water availability and the acreage of recreation land available.

Socioeconomic characteristics at time t = the characteristics of the i^{th} individual in time period t.

The use of lagged variables was based on the assumption that some determinants of recreation behavior in period t actually had their impact in the period $t - 1$, the previous period. Cicchetti *et al.* (1969) suggest that learning by doing (e.g., the tendency for people to fish more once they have fished), communications (e.g., learning about new fishing areas), and past recreation habits are determinants of behavior that should be included as time-lagged variables in predictive models.

An additional methodological refinement used by Cicchetti *et al.* (1969) was the use of a two-step procedure to forecast recreation consumption. The first step consists of developing an equation to predict the probability of an individual's choosing to participate in a particular recreation activity. The second step estimates the amount of the activity in which he is likely to participate. The two-step procedure represents a refinement in model construction since it begins to incorporate the decision process of the consumer. The two-step model was based on the assumption that different variables would interact to determine, first, whether or not a person is likely to participate in an activity, and second, how much he is likely to participate.

A further modification offered by Cicchetti *et al.* (1969) was to deflate recreation supply variables on a per capita basis, rather than use absolute quantity measurements. Deflated supply variables reflect the relative, rather than absolute, recreation supply available to a particular population.

Even with the innovative changes introduced to refine existing techniques, results of the Cicchetti studies were disappointing. For the 24 recreation activities considered, the resulting models showed very low predictability. There are several possible reasons for this--not necessarily attributable to the Cicchetti model but to the method in general.

Even with the inclusion of supply variables, such models have usually resulted in low predictability.
Part of the problem is the lack of precise regional population data. But data collection is expensive and model construction is often tied directly to constraints imposed by data contained in the U.S. population census. The relationship between predictor variables is difficult to determine; e.g., the individual "net" effect of causal variables on recreation participation.

All such models are static in that they assume that the observed relationships between predictor variables and recreation consumption will remain constant to the projection year. Finally, most models that predict recreation consumption are based on socioeconomic variables that reflect past recreation behavior. Projecting the predictor variables to some future date is, in and of itself, likely to introduce considerable error into consumption forecasts.

Although progress has been made, a further restriction is that the models seldom include the influence of changes in facility supply on consumption. Most often, such models contain the implicit assumption that a constant relationship will exist between the mix of recreation facilities available now and the mix of facilities available during the prediction year.

Although the approach has inherent limitations, it provides a basic framework on which to develop comprehensive recreation forecasting models that are suitable for long-run resource decision-making purposes.

Demand for a Specific Resource

Consumption models for a specific resource have been developed in response to

a need for on-the-ground planning information. Many of the techniques described in the previous section have application to forecasting consumption for a specific resource. The main difference between regional models and models for a specific resource is in the scope of the model and the way in which data are collected. Data collected through national user surveys are of little value in developing models to forecast recreation consumption for a particular resource.

Although it is often done in regional forecasts, it is incorrect to assume that all recreation areas that provide facilities for a particular activity will receive an identical proportion of use. There are several reasons why facilities do not receive similar use intensity. The amount of recreation consumed differs between areas depending on characteristics of the population served, climatic variation, and relative transportation availability. Different recreation areas vary in attractiveness. Finally, the supply of substitutable recreation facilities within a particular region will influence consumption at individual facilities within that region.

Models that forecast use for specific recreation facilities fall into three categories: resource capacity, supply characteristics, and gravity models.

Resource Capacity

The saturation or resource capacity approach is often used to establish absolute upper limits on the amount of recreation that an area can sustain, or on the amount of physical resource that can be developed for recreational purposes.

The saturation approach is based on the assumption that upper limits to recreation consumption are imposed by sheer numbers of people who want to engage in a particular recreation activity, for which resources are fixed. The approach assumes a finite resource and an effectively infinite recreation demand. Under the assumption of infinite demand, forecasts of recreation consumption are simply not needed. The approach assumes that increasing recreation consumption can only be met by resource development up to a certain point. After the maximum is reached, resource deterioration will occur because of the excessive number of users. When this occurs, equitable management control systems need to be established to allocate use in order to maintain the basic resource integrity.

Recreation development planning based on resource capacity usually begins by inventorying the resource to determine its physical development potential. Once carrying capacities are established, resources are developed and use pressure is kept within resource capability limits. Use controls would then be initiated to maintain the resource.

The saturation principle and resource limits approaches have merit when the recreation resource of concern is relatively fixed. Some National Parks, where consumption levels exceed carrying capacity, provide examples (Conservation Foundation 1972). In such instances, the decisionmaker would benefit very little by knowing that if he *could* expand available supply, recreation consumption *would* increase to some estimated level.

At least for the immediate future, the saturation or resource limits approaches to planning do not provide the flexibility needed for the majority of recreation planning decisions. In most planning situations, resource capability is not fixed and demand is not infinite.

Supply Characteristics

A number of models have been developed to determine relationships between use intensity and physical characteristics of recreation facilities. The mathematical models describe the relationship between physical characteristics and recreation use over a season, peak-use period, etc. Distances between recreation areas and population centers are often included as variables in supply models.

An example of the supply approach is a regression model developed by Shafer and Thompson (1968). The model takes the form:

$$U = 3409 - 0.0183\, X_1 + 0.1757\, X_2 (X_3 \cdot X_2^2)$$

where: U = number of groups visiting an Adirondack campground per year.

X_1 = total square feet of land and water area at the campground swimming beach.

X_2 = total number of campsites in the campground.

X_3 = total number of islands accessible by motorboat from the campground.

This model accounted for 98 percent of the variation in seasonal use among the 24 Adirondack campgrounds studied. The site variables can be easily measured for any one campground and plugged into the equation to provide an estimate of annual use.

Using a similar approach, Seneca and Cicchetti (1969) developed a model that accounted for 74 percent of the variation in the number of visits to 154 recreation sites located in the Appalachian Region. The variables included in their equation were several supply characteristics of the recreation sites and whether or not a user fee was charged. Another example of the supply approach to forecasting recreation use is a model developed by Echelberger and Shafer (1970) which estimates the use of 26 ski areas in the Northeast from three site variables plus a distance measurement. The model explained 71 percent of the variation in total visitor-days among the ski areas.

Predictive models based on supply features usually account for a high proportion of past recreation use. A major limitation to supply models, however, is that they correlate past use to past supply features. The models explain what happened in the past, but are of limited value in determining what is likely to happen in the future. Examination of the predictor variables used in supply models usually shows that the size of a recreation area, in terms of facility units, is strongly correlated with recreation use. The obvious conclusion is that the bigger an area, the more use it has received. The relationship reveals little about predicting consumption, but merely implies that an increase in supply will result in an increase in consumption.

Supply models can be used to explain why some recreation sites are more heavily used than others. But they are of limited value in forecasting overall recreation consumption. This is particularly true for new recreation facilities. But past research has shown that supply characteristics are important determinants of consumption and they must be included in comprehensive forecasting models.

Gravity Models

The gravity model is an attempt to establish a mathematical relationship between the relative location of population masses and frequency of visits to a given recreation facility or group of facilities. The basic extension of the gravity concept to recreation facilities was proposed by Hotelling (1947) and Trice and Wood (1958), and further developed by Clawson (1959). The gravity model evaluates the use of an area or areas as a function of distance in miles or time traveled from a population center or centers to the recreation area. The model simply stipulates that as distance to a recreation area increases, the use of the area decreases according to some mathematical function.

Adaptations of gravity models have been used in three ways: by Clawson (1959) and Cesario (1969) as an approach to evaluating economic demand (price/quantity) for a particular resource; as a way of relating distance to recreation use (Smith and Kavanagh 1969); and as a component of larger models that combine socioeconomic user characteristics, resource supply features, and distance to allocate recreation consumption.

Various approaches have been taken to quantify the monetary value of a recreation resource. The basic approach suggested by Hotelling has been extended by Clawson (1959). Clawson's procedure involves two steps. First, a demand curve is constructed for the entire recreation experience. The distance traveled from various zones surrounding a recreation resource is used as an index to cost. The method assumes that distance is the major cost under conditions where a recreation experience is priced at a near zero level. A schedule or table is derived that relates the number of people visiting a recreation area per 1,000 base population within a distance zone to travel cost per visit per party. Under the assumption that increases in unit admission price will influence consumption equally across distance zones, the second step consists of constructing an economic demand curve for the recreation experience. Clawson's basic gravity relationship has been fur-

ther refined to approach the difficult problem of deriving economic demand curves for outdoor recreation (Knetsch 1963, Ullman and Volk 1962, Merewitz 1966).

The gravity model has been used in numerous studies to relate use of a particular recreation site to distance traveled to the site. Smith and Kavanagh (1969) used the gravity relationship to construct a reliable model that described the number of visits to a 1,570-acre reservoir in England per 10,000 population residing in urban areas within an 80-mile radius. The model provides estimates of use emanating from urban and rural population density zones as a function of distance from the reservoir.

Wennergren and Neilsen (1968) determined the relationship between the number of boating trips taken by a sample of 9.2 percent of the boaters in two northern Utah counties and the travel distance between a respondent's residence and a particular lake. Their equation explained 80 percent of the variation in the probability that a given recreationist would visit any one of 22 alternative water recreation sites.

Several problems are encountered in applying the simple gravity relationship directly to recreation consumption models. Although distance is certainly one of the major determinants of recreation behavior, it is but one of many factors that influence consumption. Alternative recreation facilities available to a given population should be incorporated in comprehensive models. Recreation site capabilities and development potential are usually not given adequate consideration. Perhaps the most important limitation to the gravity model is that dynamic changes within the population served, such as shifts in income and occupational structures, are not normally included as variables that will influence future recreation consumption.

Systems Models

The systems approach to forecasting recreation consumption for a site, complex, or region, provides the flexibility needed to incorporate the many complex relationships that underlie the recreation consumption process. Large systems models can be used to generate consumption estimates and to allocate consumption between regions, or among specific recreation sites within regions.

In general, the systems approach treats the recreation system as if it were an electrical circuit analog. Population centers act like sources of current (potential consumption). This current flows along paths of least resistance (highways), and eventually reaches its destination (recreation sites). A systems model should specify the interrelationships between all operating components. It should describe how wildland recreation resources, facility supply, and the recreational needs and interests of people interact to produce "effective" recreation consumption patterns. The system should be flexible so that management and policy alternatives can be introduced to determine their effects on the operation of the system.

The process used to develop a systems model includes: definition of system limits--parameters and major components (geographical area, recreation activities of concern, relevant population, etc.); identification and mathematical description of system components; computerized representation of the system; and system modification to conform to observed recreation behavior patterns. Once the model is operational, parameters can be manipulated to determine their effects on system operation and recreation consumption patterns.

The gravity relationship has been applied to recreation systems models in numerous studies (Cesario 1969, Wennergren and Neilsen 1968). The basic formulation involves determination of recreation pressure emanating from user origin areas, and then allocating the recreation pressure among recreation destinations. The distance between origin and destination acts as a resistance to flow along an origin-destination link. Link resistance can be measured by highway distance, road quality, travel time, travel cost, or some combination of these measures. The resistance due to distance can be adjusted to reflect the drawing power or attraction of a particular recreation destination. Attraction indices for recreation sites reflect their relative desirability for a particular activity.

The Recreation System (RECSYS) model developed by Ellis (1966 Part I and II, and 1967) and Chubb (1967) was among the first application of a systems model to comprehensive recreation planning. The

RECSYS formulation was initially developed for application to 12 major recreation activity groups. Because of the scarcity of recreation activity data, the model was developed and applied to boating activity in Michigan. The RECSYS model allocates boating activity originating within 68 Michigan counties or pairs of counties and six out-of-State areas to 72 counties or pairs of counties within the State.

Boating demand pressure is assumed to act through nodes located within origin areas or through major entrance points for out-of-State boaters. Destination nodes, the points through which user pressure is dissipated, are designated as the geographic center of boating resources for each destination area. Origin nodes are connected to destination nodes by highway links. Distance, tolls and travel time are used to compute travel resistance along each origin-destination link.

To bring resource supply into the system, a boat use capacity index is calculated for each destination. A subjective system is used to develop attraction indices for destinations. Included in the destination attraction indices are factors such as lake size, fishing potential, and percentage of warm water lakes.

Base year data from a 1966 Michigan Waterways Commission boating needs survey were used to construct the initial RECSYS model. The survey data provided information on the origins of registered boaters, as well as the counties in which they boated, and the amount of boating done at destinations. The sample data were expanded in proportion to the total number of registered boaters within each origin zone and calculations were made to determine the total amount of boat use generated at each origin and used at each destination.

Once the data were compiled, the computerized model was run, and results compared to actual observed boater behavior. Components of the model (destination attraction indices, highway link costs, and highway trip distance) were reevaluated, and the model calibrated or mathematically adjusted to fit observed boating behavior.

Once the model is calibrated, changes in highway links or other model components can be projected to produce future data. Supply adjustments can also be introduced for the projection year to reflect facility construction and resultant changes in attraction indices at destination nodes. These projected changes in model components can be tried to determine their effects on the operation of the system. Once parameter estimates of the model are projected to some desired year, the RECSYS model can be used to forecast recreation consumption at destination areas. A mapping technique has been coupled to the system so that supply requirements or deficiencies can be easily identified. As better input data become available, the RECSYS model can be improved (Recreation Research Consultants 1972).

Another extension of the systems approach to forecasting recreation use is the transportation analysis system being developed for national forest planning. The basic model has been developed by the Institute for Transportation and Traffic Engineering (1971) at the University of California, in Berkeley. The recreation systems model is one of several transportation models under development.

The Institute for Transportation and Traffic Engineering (ITTE) recreation model is made up of several submodels. The two basic types of models are: macromodels that generate and distribute recreation consumption from major urban areas in California to National Forests in California; and micromodels that distribute trips among recreation facilities within a particular National Forest. Both the macromodel and the micromodel incorporate an attraction model used as an index to the relative drawing power of a forest or developed recreation site within a forest. The attraction models are used to compute an attraction index based on recreation-related characteristics of a particular forest or a recreation site within a forest.

Like the RECSYS model, the ITTE model requires base year inventory data to calibrate the initial system. Inventory input data include physical measures of regional and forest transportation systems, forest resources, facility characteristics, and characteristics of people living in population centers that interact with a forest. Recreation activity data include the type, amount, and kind of recreation use, as well as the origins and destinations of recreation users. Travel patterns and preferences within and between

forests must be determined through recreation user surveys.

The three components of the macromodels are population centers (population origins), transportation impedance (highway travel time, cost, and distance), and forest attractors. Forest macroattraction models are developed using three factors that relate to water, land resources, and recreation facilities available. Micromodel components are similar, except that the attractor model is developed for specific sites within a forest. Microattraction models for individual sites are determined for each recreation activity of concern; e.g., fishing, camping, and swimming.

The macrogeneration model utilizes population size, county income, age distribution, and National Forest accessibility to estimate mathematically the recreation pressure emanating from a particular population origin zone. It estimates the quantity of trips generated at origins, regardless of where the trips are distributed.

Although still relatively new, the systems approach provides the most comprehensive method for forecasting and distributing recreation within and among recreation resources. But as Cesario (1969, p. 42) points out, in general the systems approach,

> "...suffers from the same problems of other methods in that the variables have been measured and each component modeled before the analysis can proceed. In addition, the assumption of a linear system is restrictive. Since each travel link is modeled separately, the model does offer the strong possibility of introducing peak congestion into the analysis--something that has not been accomplished with other models."

In addition to the conceptual problems involved in building systems models, the approach relies heavily on resource supply and recreation use data. The precision to which the model can be developed depends on the size of the geographic unit from which data are collected; i.e., State, county, or local level. A computer is necessary and specialized personnel are required for initial model construction.

Althcugh the systems model is complex and has heavy data requirements, it is comprehensive and all relevant components that influence recreation behavior can be included. As recreation supply and recreation inventory data become available, the systems model will undoubtedly become a valuable planning and decisionmaking tool.

DEFICIENCIES OF ALL METHODS

All methods used to forecast recreation consumption have inherent deficiencies. Some methods are better for specific purposes than others. Two important factors that are seldom adequately considered in forecasting models are the quality of recreation experience associated with a particular level of recreation consumption and the impact of technological developments on future consumption patterns. Few models inherently recognize the role that management can play in influencing consumption.

A reliable forecast of expected recreation consumption will provide managers with needed planning information. An ideal method would recognize the tradeoff relationships that exist between quantity of recreation consumed and quality of recreation experience received. The influence of the quality of experience on quantity consumed is implied in some of the systems approaches via attractiveness indices for specific recreation resources. Most attraction indices, however, are based on physical features of the resource, not necessarily on the quality of experience received.

More research is needed before the qualitative aspects of recreation experiences can be incorporated into recreation forecasting models. Some research attention has been devoted to the study of qualitative aspects of recreation experiences and environments. For example, in a study aimed at developing a system for rating natural landscapes, Shafer *et al.* (1969) developed a model that explained 66 percent of the variation in preference scores for a wide range of natural environments described by black and white photographs. A similar study by Peterson and Neumann (1969) utilized a psychological testing instrument (semantic differential) to develop a model that explained 94 to 98 percent of the variation in preference scores for Chicago area beaches. Other examples of studies designed to measure intangibles are those by Lansing and Marans (1969), Kasmar (1970), and Neulinger and Breit (1969). But little quantitative research

as been conducted into recreation motivations, expectations, and satisfaction received.

Most approaches to forecasting recreation consumption do not incorporate the dynamic changes of technological impacts on recreation behavior. Technology will have a major impact on recreation behavior through changes in equipment design, environmental management, and environmental control systems. Predictive models should be sufficiently flexible so that relevant parameters can be altered as new technological developments are introduced.

Finally, recreation consumption models need to incorporate the role that management and policy play in influencing consumption. Most models implicitly assume that the interaction between managers, recreation users, and resources will be constant through time. In the past, management has largely reacted to recreation pressures, rather than acting to meet or influence these pressures. As indicated in the Conservation Foundation's Report to the National Park Service (1972), recreation management policy must play an increasingly important role in influencing recreation behavior in the future.

CONCLUSIONS

Planning must rely on forecasts no matter how imperfect the forecasts may be. All of the methods used to forecast recreation consumption, from the simplest trend extrapolation to the most complex systems model, have been found lacking in some respect. Yet much progress has been made in a short time toward providing needed estimates. Advances in computer technology, coupled with better data collection systems and more intensive research into the processes that determine recreation behavior, will undoubtedly allow more precise forecasting models to be developed in the future.

Yet we must not be overly optimistic. Prediction in social systems is at present more an art than a science. The essence of the problem was underscored by Kenneth Boulding when he cautioned (Rosenberg 1971):

"The careful planner if he can
Should always plot to change his plan;
And if he follows sound directions
Will not believe in his projections
For population growth depends
On many contradictory trends,
Though sex can be predicted (maybe!)
We're much less certain of the baby
...
"The future, then, is most uncertain,
And lies behind a heavy curtain.
It's bound to have some kind of strings,
So let's prepare for lots of things
(Especially to switch and swerve)
And not hitch wagons to a curve."

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LOCATING AND DESIGNING CAMPGROUNDS TO PROVIDE A FULL RANGE OF CAMPING OPPORTUNITIES

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ABSTRACT.--Discusses the location and design principles of campgrounds accessible by automobile including: (1) the need for variety within a region, (2) the kinds of campgrounds and where to locate them, (3) the role of private and public campground managers, (4) the role of design in reducing physical resource deterioration, and (5) the role of location and design in enhancing the experiences of campers.

THE PROBLEM

Today, demands for recreation facilities are great, suitable land is often scarce, and land management decisions are being contested by a variety of publics. Planning decisions must, therefore, be carefully made with a clear understanding of the interrelations of people, physical resources, location, and design. To achieve good location and design of campgrounds, a recreation manager must carefully evaluate the relative merits of alternative locations and different kinds of campgrounds.

Poorly located and poorly designed campgrounds can be a millstone around the neck of the recreation manager. The private operator can lose his entire investment; public agencies pretty much have to live with their mistakes. Construction costs per family unit in Forest Service campgrounds, for instance, range from $2,000 to $5,000.[1] Once construction begins, a decision to relocate the facility or make drastic changes in the design of facilities is probably too late.

Considerable research suggests that many campgrounds are not doing the job intended, in some cases because of poor location and design. Some campgrounds go practically unused (Burch 1964; Love 1964; Lucas 1964, 1970; Beardsley 1967; Shafer and Thompson 1968; Shafer 1969; Lime 1971). Many private campgrounds have difficulty showing an adequate return on their investment (LaPage 1967, LaPage *et al.* 1972). Poor location and design sometimes cause wide variations in the use of campsites *within* campgrounds (Love 1964, Lime 1971).

My purpose is to discuss the location and design principles of developed campgrounds (those accessible by automobile) particularly on public forests. The paper is divided into (1) the need for variety within a region, (2) the kinds of campgrounds and where to locate them, (3) the role of private and public campground managers, (4) the role of campground design in reducing physical resource deterioration, and (5) the role of location and design in enhancing the experiences of campers.

NEEDED: A VARIETY OF CAMPGROUNDS REGIONALLY

Traditionally, campgrounds have been viewed by many recreation managers as a means of "controlling" visitors to insure the protection of the natural environment. Concentrating people in a small area also has enabled more efficient law enforcement and fire control. As demand for campgrounds grew, new facilities often were immediately built or existing areas modernized or enlarged, to "handle" visitors as efficiently and as cheaply as possible. Additional campsites were often built between existing sites with little regard for the satisfaction of campers. Consequently, many small, informal campgrounds have been replaced by large, modern, intensively developed campgrounds. This and other changes in the layout and design can greatly alter the values derived by present campers. The process of "creeping" campground development forces out a sizable segment of the camping population that is seeking solitude and contact with nature (Hendee and Campbell 1969). In many areas these "displaced campers" can no longer find the small, primitive campgrounds that they enjoy.

To meet these demands for campgrounds, standardized facilities have often been built in very dissimilar environmental set-

[1] *Includes road, water, sanitation facilities in addition to the campsite itself.*

tings. The underlying rationale seems to have been that "campers are campers," and they will use *and like* whatever is provided for them--supply creates its own demand (Lime 1972). This thinking is evident in the numerous space standards reviewed in "Outdoor Recreation Space Standards" (Dep. Inter. 1967). Despite the wide range of standards, most were developed from intuitive judgments and trial and error rather than from research (Lime and Stankey 1971).

In reviewing nearly 100 studies of campground use and visitor attitudes, I concluded that trying to provide facilities that are thought to satisfy the "average" camper contradicts the major objective of outdoor recreation management. This objective is to provide pleasing and rewarding experiences for all kinds of campers (within certain administrative, budgetary, and physical resource constraints, of course).

A growing body of research clearly demonstrates that the so-called "average" camper doesn't exist (Shafer 1969). Rather, many seemingly independent groups of campers exist, each with their own preferences for different kinds of camping (Bury 1964; Burch 1964, 1965; Green and Wadsworth 1966; Bultena and Klessig 1969; West *et al.* 1969; Moncrief 1970; Clark *et al.* 1971; Hendee *et al.* 1971; Taylor and Knudson 1972; Merriam *et al.* 1973).

Several authors have emphasized that while traditionally camping had an environmental orientation for participants, more recently camping has become much more of a social experience (Etzkorn 1964, Bultena and Klessig 1969, Hendee and Campbell 1969, Clark *et al.* 1971). Even the most casual observer is aware of the resulting trend toward convenience and "creature comforts" in camping. Paraphernalia used by campers is more sophisticated. Many campground franchises have become potential "camping resorts" such as Holiday Inn Trav-L-Parks, Kampgrounds of America (KOA), and Jellystone Parks. This evolution in campgrounds has led to an increasingly diverse camping population with varied and often conflicting desires, and it has important implications for the location and design of campgrounds.

Because of the diverse benefits being sought by campers, planners should provide a wide spectrum of camping opportunities within a given geographic area (Wagar 1966). There is an obvious need for collaboration among the various private and public campground managers to make sure a full range of opportunities exist (Burch 1964, Krutilla 1967, Goldin 1972). No one manager need feel obligated to meet the demands of all campers, however. Each public agency, for instance, could meet a part of the demand, and refer campers wanting something different to another campground (Lucas 1963). Progress is being made through long- and short-term management plans, but more coordination is both necessary and desirable.[2]

Efforts by recreation managers to insure a range of camping opportunities in a region must be matched by effective publicity to inform potential campers where the various types of campgrounds are. Many imaginative techniques to communicate with recreationists are possible, such as visitor information centers in metropolitan areas and greater use of radio and television. Communication can also serve to educate recreationists in basic outdoor values, ecological concepts, and management policies.

WHAT KINDS OF CAMPGROUNDS AND WHERE TO LOCATE THEM

A decade ago Alan Wagar (1963) developed a useful classification of campgrounds needed to serve different purposes. Five of the seven types he identified are campgrounds accessible by automobile: (1) travelers' camps, (2) central camps, (3) forest camps, (4) peak-load camps, and (5) long-term camps. More appropriate terms for central camps and forest camps might be "social- and environment-oriented campgrounds." These terms will be used hereafter.

Each type of campground has distinctive location and design criteria. The relative level of development and accessibility can be graphed for each type (fig. 1). Generally, *elaborate* campgrounds have flush toilets, sewer and water hookups, electricity, a store, and other conveniences. These campgrounds usually have many family units with little space between units. Conversely, *simple* campgrounds typically have only vault toilets and well water; family units are few and widely spaced. Admittedly, a small campground could have elaborate facilities (flush

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[2] *Recent communications with State campground planners in Michigan, Minnesota, and Wisconsin indicate some public agencies are defining the type of campgrounds they will provide. They realize that the private sector has to meet the specialized needs of a different portion of the camping population.*

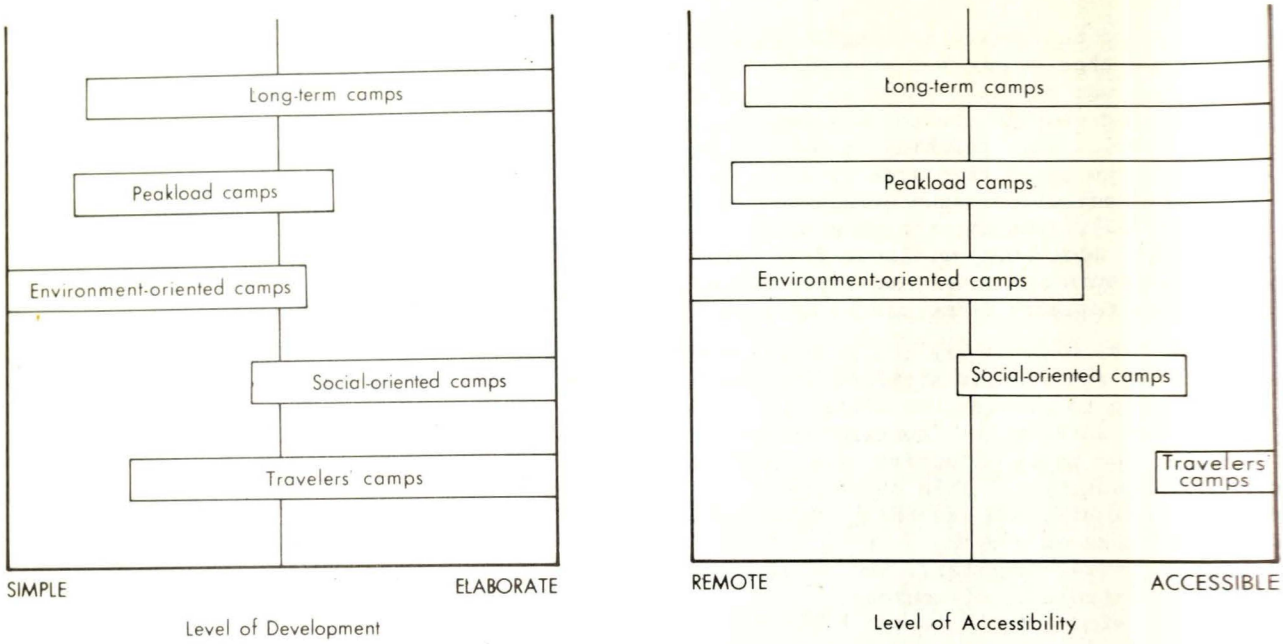

Figure 1.--Relative level of development and accessibility of five types of campgrounds. (The terms "simple" and "elaborate" denote a range in character and number of facilities.)

toilets and electricity) and widely spaced family units. Its relative position on the continuum of development in figure 1 would be intermediate, however.

No attempt is made in this paper to identify the relative supply or demand for the various types. It is assumed, however, that a mix of campgrounds is needed now and will continue to be needed in the future.

The Travelers' Campground or Open-air Motel

Travelers' campgrounds emphasize convenience for the transient camper and are generally located near main highways in pleasant settings. They should be distributed throughout a region not only in rural areas but also near (or perhaps *in*) large and small urban areas. A review of several commercial campground directories showed that very few campgrounds now exist in or near some large metropolitan areas. Only two campgrounds (totaling 28 family units) are located within 20 miles of downtown Milwaukee and only one campground (11 units) is within 20 miles of the Chicago Loop (Rand McNally and Company 1973).

Most travelers' campgrounds are elaborate and have flush toilets, electricity, showers, laundry facilities, a grocery, and other conveniences associated with motels. There undoubtedly is some demand, however, for a variety of simpler travelers' campgrounds as well. Perhaps some travelers' campgrounds could be imaginatively designed for those who want both access to conveniences and isolation in natural surroundings. A modernized section could have peripheral campsites with simple facilities, wide spacing, and vegetative screening. These campsites could also provide accommodations when the modern section was full.

The Social-Oriented Campground

Social-oriented campgrounds would attract weekend or vacationing campers rather than transients. Campgrounds would be located in pleasant surroundings several miles from main highways, and would be reached by high speed rather than secondary roads. Social-oriented campgrounds should be located on the fringe of large areas of public land, rather than in the interior. Their location should be intermediate--not accessible enough to attract transients, but not so remote as to conflict with campers seeking isolation and communion with nature. Ideally, they should be distributed in all parts of a region.

Campgrounds would be intensively developed with conveniences like electricity, flush toilets, showers, sewer and water hookups, laundry, and store. Imaginative facilities such as playgrounds, riding stables, and boat rentals also serve to attract customers. Obviously, numerous levels of development are possible and desirable. These campgrounds typically would be large (with more than 50 campsites to several hundred) and spacing between units would be close to enhance interest in socializing among campers (Etzkorn 1964).

The Environment-Oriented Campground

Because visitors to these campgrounds want direct contact with nature, environment-oriented campgrounds should be located farther from main highways and near highly valued recreational attractions like trails, outstanding vistas, unique landforms, water features, vegetation communities, and geologic formations. Low speed (perhaps gravel) roads could be the only access for many of these campgrounds to "screen out" those campers not truly nature-oriented. In large areas of public land, the interior would be used for various environment-oriented campgrounds without intensive development (Hendee and Campbell 1969, Clark *et al.* 1971).

These campgrounds would have fewer campsites than the previous kind, usually less than 20 and never more than 50. Campsites would be moderately shaded and well screened with vegetation to insure privacy. Spacing would be wide, from 100 to 200 feet; some sites might be walk-in units and separated by 400 to 500 feet. To satisfy divergent tastes, some campgrounds should be very remote, small, and simple with only vault toilets and well water; others could combine a remote location with moderate development (e.g., running water). Research findings have consistently shown that campground design should be varied (Lucas 1970, Lime 1971).

The Peak-Load Campground

When campgrounds exceed their designated capacity on holidays and opening day of fishing or hunting season, temporary or peak-load facilities are required. Provision for peak-load camping should be considered in the planning and design stages of all campgrounds. Some campsites could be left semifinished (excluding barriers, walkways, toilets, tables, and hand pump or water system hookups) to serve as overflow areas and a means for measuring the need for additional campground units before large sums of money are further invested.

Similar reasoning could be employed in developing temporary hunting and fishing camps in locations away from existing campgrounds. A campground access road with a small loop or cul-de-sac and perhaps parking spurs would be required. The road could be blocked and visitors excluded when the area is not needed. Camping areas of this type might also serve well the needs of large groups, organizational parties, and persons on field trips. As regional demand increases some peak-load camping areas could be turned into full-time campgrounds.

In campgrounds that are already developed, overflow camping can be provided in adjacent meadows or clearings where wide spacing between sites can partially make up for a lack of screening vegetation. Facilities such as toilets, tables, and drinking water systems should be kept simple and portable if possible.

The Long-Term Campground

These campgrounds serve the minority of the camping population who prefers to either leave their equipment at one place and repeatedly return to "their campsite" perhaps on weekends, or stays for a month or so at a time in the same location. This type of campground typically would not serve travelers, but travelers' campgrounds might have some campsites for long-term users.

Long-term campgrounds could have characteristics of either social- or environment-oriented camps, but I suspect most long-term campers are socially oriented and most demand would be for intensively developed campgrounds.

On public lands, long-term campgrounds should not compete for land needed for other types of campgrounds. If competition develops, long-term campgrounds should be phased out and converted to social- or environment-oriented campgrounds, depending on the level of development and location.

THE ROLE OF PRIVATE AND PUBLIC CAMPGROUND MANAGERS: WHO SHOULD PROVIDE WHAT

In a recent paper Angus, Corssmit, and Foster (1971) presented a conceptional framework for providing various kinds of developed campgrounds by private and public managers. Their basic thesis is that "... when the private and public sectors can do an equally satisfactory job of supplying facilities, private supply is preferable." They empha-

size that public campground managers may need to stimulate the supply of facilities during the early stages of the growth of the market, but should stop further development when the private sector responds to increasing demand.

In the past, the public sector has supplied the bulk of America's developed campgrounds. More recently there has been a large expansion in the number of camping areas provided by private industry. One writer notes that during the past few years, the number of private campgrounds has grown at the rate of some 2,000 annually (DeMattis 1973). In Minnesota, for instance, in the early 1960's, there were fewer than 10 private campgrounds; today there are nearly 400. This suggests that it is a good time for public agencies to reevaluate their roles in providing developed campgrounds.

In cases where the private sector does not show an ability or interest in providing campgrounds, public agencies may have to provide them. It is my observation in the Lake States, for example, that the private sector has not responded to people desiring primitive, environment-oriented campgrounds. If more campers were to seek primitive outdoor experiences in the future, the interests of businessmen could change (Krutilla 1967, Hendee 1969, Burch and Wenger 1967).[3]

Careful collaboration among public and private campground managers can insure a full range of camping opportunities within a region. It is suggested that the various public agencies and the private sector could each provide campgrounds of a certain level of development; all together they would provide the whole range of campgrounds from simple to elaborate (fig. 2). Federal agencies, for instance, would have a major role in providing low-density, simple campground development. In some cases they might provide a few intensively developed camping areas where private campgrounds do not yet exist and where profitability is questionable.

Who should provide the five types of campgrounds identified earlier, public or private managers?

Travelers' campgrounds should be operated largely by private owners on private

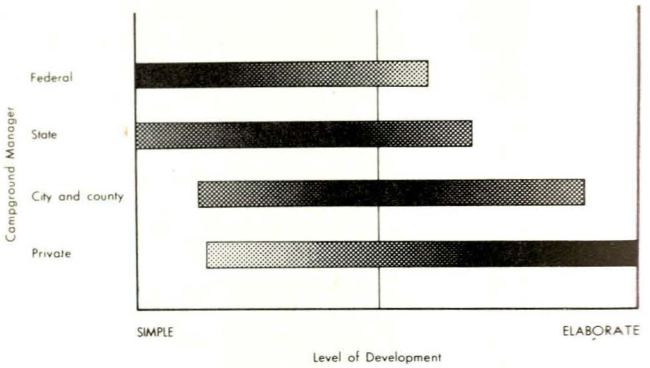

Figure 2.--Suggested levels of development for public and private campground managers. (Densely shaded part of bar represents level of development most managers should provide.)

lands, or by concessionaires under special use permits on public land. This pattern develops naturally in areas of little public land. In areas of extensive public holdings, however, public managers should seek out and encourage private development on adjacent private lands, or least suitable public land on the periphery to private managers.

Social-oriented campgrounds generally should be operated by private entrepreneurs rather than by public agencies. However, in areas where the private sector shows no interest in responding to a demand for elaborate campgrounds, the public sector has the responsibility to provide them. As circumstances change, the public facilities could be leased to an interested private manager under a special use permit, thus avoiding competition between the public and private sectors.

Because of their interior location in a public forest area, environment-oriented campgrounds most likely would be operated by the public agency rather than by a concessionaire (although concessionaires might be appropriate in locations nearer the periphery of the public land). If the private sector demonstrates an ability and interest in providing these more primitive camping areas, the public agency should work with them to provide a variety of campgrounds in the region.

Peak-load campgrounds might be operated by either public or private managers. Private campgrounds might well have an overflow area adjacent to existing campsites, but it would seem unlikely that peak-load camping as a business would be very profitable. Some resort and restaurant operators and other

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[3] *Some believe that persons initiated to car camping at an early age (in intensively developed camping areas, for instance) may seek more primitive developed campgrounds as well as wilderness as they become older.*

merchants with sufficient land located in prime tourist areas might be able to supplement their incomes by providing temporary campgrounds.

Long-term campgrounds probably should be operated by owners of private lands or by concessionaires on public lands because these camping areas give exclusive use to a few campers. This type of business venture might be appealing because of the more predictable income it could provide.

THE ROLE OF CAMPGROUND DESIGN IN REDUCING THE DETERIORATION OF PHYSICAL RESOURCES

Management can use several techniques to protect soil, vegetation, wildlife, and water in and around a campground: proper location of roads and trails, proper placement of facilities, channeling pedestrians and vehicles, hardening trails and roads, fertilization, reseeding, and rotation of use.

Meinecke (1932, 1934) long ago recognized the importance of properly locating roads and facilities in campgrounds, as did Taylor and Hansen (1934). These observers recognized the campsite and parking area as an integral unit and gave advantages of both the pull-through and dead-end parking spurs. Although 40 years old, their writings are still timely and pertinent for designing campgrounds in the 1970's. I strongly recommend that planners read these articles.

These early observers also stressed the careful placement of tables, fireplaces, toilets, wells, pumps, and water hookups. For example, Meinecke identified the campfire area as a significant part of the camping experience, and articulated the importance of locating the fireplace so that prevailing winds assure good draft without driving smoke over the table and tent.

To protect onsite vegetation and reduce erosion, tent pads should be large enough to accommodate tents in common use today. A recent study in a Forest Service campground in Tennessee showed that 26 percent of the tent campers had tents larger than the pads (Cordell and Sykes 1969). Because more and more campers have screen houses and may bring two or more tents, planners should consider building more than one pad per campsite.

Damage to the campsite can also be minimized by providing some areas where two families or clubs can camp together on the same site. Group camping appears to be increasing, so planners should consider providing multiple-party sites on an experimental basis as part of their planning.

Proper channeling of pedestrians and vehicles helps to reduce wear on resources. Posts, logs, rocks, fences, and guardrails can be used to keep vehicles in parking spots and out of campsites (Magill 1970). Paths, elevated walkways, and bridges can similarly channel foot traffic. Pathways should not be selected arbitrarily, however. Routes that are picked simply because they happen to be the cheapest or easiest to locate probably will do little to enhance camper enjoyment and may not be used (Lime and Stankey 1971). Letting visitors choose their own routes around the campground and then hardening the paths with native stone, gravel, wood chips, or pavement is not always satisfactory either; an unnecessarily large amount of ground can be paved this way. More research is required on pedestrian traffic flow in campgrounds.

Ground cover and soil are commonly damaged by concentrated use (Stankey and Lime 1973). Fertilization, reseeding, and irrigation can help rehabilitate campgrounds. Prohibiting use of sites after fertilizing, for example, would permit worn campsites to recover. Campgrounds could be designed so that sites are rested 1 year in 3 (Lime and Stankey 1971). This could be done by constructing three distinct areas or loops with separate access roads and closing off a different one each year. During peak use, certain sites could be temporarily used. Admittedly, this would be costly and require expansion by at least one third; but, coupled with a continuing maintenance program, the results could be rewarding.

In summary, protecting the physical resource by good location and design is considerably more than making a few field observations, preparing maps, and then turning the construction and installation over to road engineers and others less sensitive to the delicate ecological and social consequences of construction. Good location and design must include even small details. For instance, a campsite might have a pleasant view of a lake, be well screened, and spaced far from other sites, but poor placement of the tent pad could cause excessive erosion--not to mention the dissatisfaction to campers during wet weather. Positioning the tent pad 5 or 10 feet one way or the other could make the difference between an eroded site and a stable one.

THE ROLE OF CAMPGROUND LOCATION AND DESIGN IN ENHANCING VISITOR ENJOYMENT

Proper design and location not only helps protect the resource but also increases visitor enjoyment because most campers spend so much time at the campsite relaxing, cooking, and tidying up (Burch 1965, King 1966, Hendee and Campbell 1969). But how do visitors want campsites located and designed?

Many studies have been made in developed campgrounds to answer this question. Campers have been asked nearly everything from their opinions about the spacing between individual units to the design of fireplaces and grills (e.g., see Shafer and Burke 1965; LaPage 1967, 1968a; Cordell and Sykes 1969; James and Cordell 1970; Lucas 1970; Lime 1971; Cordell and James 1972).

Unfortunately the results of these studies are not often comparable because the studies have been conducted in dissimilar camping environments which attract people of varying tastes and environmental dispositions. Nevertheless, opinions and preferences of campers can be helpful in planning the kinds of campgrounds needed in a given area. Frequently, several alternatives are possible regarding the future development of camping areas, and knowing the opinions of visitors gives managers the basis for more viable and defensible decisions.

Space only permits discussing two aspects of campground location and design: (1) the placement of individual campsites with respect to water, and (2) the number of campsites in a campground--both of which are important to comprehensive recreation planning in the Lake States.

Water-Oriented Campsites

Water is desirable both to look at and to play in and is the focal point of many recreational activities including camping. Water increases the attraction of both whole campgrounds and individual campsites as well (Burch 1964; LaPage 1967, 1968a; Shafer 1968; Lucas 1970; Moeller 1971; Lime 1971).

Opinions differ among many recreation planners regarding how individual campsites should be placed with respect to lakes and streams. Some argue that campsites should be kept well back from the shoreline to protect it. Others contend that since water is a focal point for visitors, campsites should be located close to it. Both positions seem valid. Therefore, a compromise appears possible in which the physical resource is protected and the preferences of campers are catered to as well.

Campsites should not be placed right on the lakeshore for several reasons. Trampling can eventually destroy shoreline vegetation and cause erosion that could even affect water quality. As a result, expensive retaining structures could be required to check further degradation. All of this destroys the shoreline scenery for both the visitors in the campground and those on the water. Furthermore, many recreation planners feel that the shoreline area should not be monopolized by the nearest campers, but should be equally available to *all*. It is argued that anyone should be able to walk along the shore without feeling like a trespasser.

On the other hand, there has been a recent trend on some National Forest campgrounds in the Lake States to place many individual campsites out of sight of the water. In some of the older campgrounds, some campsites are only 20 to 30 feet from the water; while in those built since 1960, many units are as far as 1,000 feet from the water. Moreover, in many of the recently expanded campgrounds the trend has been to place campsites away from the water, usually on the back side of a campground loop road.

This trend shows that some managers have little or no understanding of users' motives for visiting the area. A recent study in Minnesota showed that nearly all campers interviewed were very water conscious and many of them came to the woods in the first place to be near water (Lime 1971). To deny campers at least a view or glimpse of the water appears inconsistent with management's objective to provide campers with the experiences they seek.

The conflict between protecting the resource and satisfying campers could be solved in several ways. Campsites could be placed back from the shoreline 100 to 200 feet so as to still allow a view or sense of being reasonably close to the water body. Vegetation can be thinned, roads designed according to topography, and frequent, well-marked trails can be built to the shoreline (Burch 1964). But some shoreline vegetation should be left to act as a partial screen or buffer between campsite and water, and to protect the soil by dispersing use at the water's edge. Shoreline vegetation would also provide natural habitat for wildlife.

Interviews with Minnesota campers did not indicate that they wanted to be right on the shoreline (Lime 1971). Being back from the water 100 feet or so would probably be

very acceptable to people as long as the water was visible and breezes could penetrate the campsite. Moreover, some parents explained that they could better supervise small children if campsites were not too close to the water.

The possible additional costs of blending campsites into the landscape to make them truly water-oriented can be justified for several reasons. First, visitors will gain greater satisfaction from these preferred sites. Moreover, many visitors may be willing to pay extra for a waterfront campsite, as research in New England State Parks showed (LaPage 1968b). Furthermore, campsites "back in the woods," far from the water are likely to receive little use except to accommodate overflow. It is wasteful to have $3,000 campsites sitting idle except for only 5 or 6 nights of use during an entire camping season.[4] A Minnesota study showed that waterfront sites averaged 60 percent occupancy compared to 25 percent for other sites (Lime 1971). Thus, waterfront campsites take the physical beating that the entire campground with its many units was originally designed to withstand. If all campsites were water-oriented, use would be more evenly dispersed and site deterioration would be reduced.

In summary, it is important for the resource manager to initiate a compromise in campground planning by preserving and protecting the shoreline as well as giving the visitor a sense of being close to the water.

Campground Size

Researchers have found that most campers like a variety of different-sized campgrounds (Wagar 1963, Burch 1964, Burch and Wenger 1967, Lucas 1970, Lime 1971). In spite of this preference for variety, some public agencies in the Lake States have been constructing mostly larger camping areas--with a minimum of 20, 30, or more units. In some National Forests, for example, this trend has been coupled with the closure of many small, primitive campgrounds (most with fewer than 15 sites).

Those who advocate large campgrounds argue that construction, operation, and maintenance costs per unit decrease as the size or number of units increases. Recent studies by Beardsley (1967) in Colorado and Manthy and Tucker (1972) in Michigan suggest that this argument is open to question and some rethinking may be in order. Beardsley, for instance, found that large facilities were not necessarily cheaper per unit to construct; factors such as the degree of rockiness or amount of earth moving required were considerably more influential. In the Lake States these factors could strongly influence cost. On the other hand, it was shown that campgrounds with more than 20 campsites were probably somewhat cheaper to operate and maintain. Although research on this topic is not extensive, available information suggests that campgrounds should be limited to 20 or 30 campsites, for example, until there is a definite need for more.

How can the costs of providing and maintaining large, medium, and small campgrounds within National or State Forests and State Park systems be reduced? One way would be to locate small campgrounds within 10 to 15 miles of larger facilities to reduce driving time during maintenance. Small campgrounds also could be located between collection points--between a ranger station and a large campground, for example. Moreover, appropriate sites that require only a short access road could be found for small campgrounds. Existing small facilities in relatively remote places are frequently classified as inefficient to maintain--especially those in which fees are collected. One solution to this problem would be a self-registration fee system. Minnesota has already initiated such a program in its State Forests. Lastly, the user satisfaction gained by providing a range of different-sized campgrounds might well outweigh the additional costs of operation and maintenance.

It would appear to be a mistake for any public agency to make campgrounds a standard size. The fact that many campers accept large facilities, provided they are well spaced and screened from neighbors, lends support to an apparent trend by some public agencies for larger camping areas and the phaseout of many medium and small facilities. Unfortunately, another sizable segment of the camper population needs and wants the small campgrounds.

SUMMARY AND CONCLUSIONS

Although research on the use of campgrounds is somewhat scattered, much useful and reliable information is available to

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[4] *From a sample of 641 campsites on 33 campgrounds in the Superior National Forest, 39 percent were used less than 4 nights during the 35-day survey in 1967--12 percent were never used. This included Labor Day weekend (Lime 1971).*

recreation planners. The following is a review of some general principles to help guide managers and planners in locating and designing campgrounds.

- The primary objective of campground management is to provide the experiences desired by campers.

- There is wide variation in the kinds of experience sought by campers who range from people interested mainly in socializing in the outdoors to those mainly interested in the environment.

- To provide for this range of tastes, there is a need for a wide spectrum of campgrounds within an area such as the Lake States.

- Campgrounds can be differentiated on the basis of their level of development and accessibility: travelers' campgrounds, social-oriented campgrounds, environment-oriented campgrounds, peak-load campgrounds, and long-term campgrounds.

- Ideally, each campground manager, public and private, would private a certain type of campground so that a variety of different types would be available within an area.

- No one campground manager need feel obligated to provide the full range of campgrounds.

- The private sector should be encouraged to provide a variety of different types of campgrounds if it is interested and able. The public sector should be flexible enough to provide a variety of campgrounds, but should generally concentrate on the simpler or more primitive types.

- A variety of campgrounds within a region is not an end in itself. Publicity is needed so campers will know where to go to find the campground that suits their tastes.

In closing, I would like to suggest two ways in which recreation managers and researchers can cooperate in solving problems of campground location and design. One approach would be for managing agencies to invite qualified researchers with specific talents to consult with them directly during the planning, design, and construction of campgrounds. Assignments could last from several weeks to a year or more during which the participant might change residence. Participants would need a high degree of objectivity and realize that some traditional ways of doing things might need to be changed. Exchanges would be fruitful to the maturity of researchers also. It would expose them to new problems of recreation management and planning, and could help them more clearly identify future research needs. Although there are probably few organizational constraints to this approach now, I know of only a few instances in which it has been done.

A second way would be for researchers and managers to conduct studies cooperatively in which imaginative campgrounds are planned, built, and rigorously tested to disclose both social and ecological consequences. For instance, studies could focus on: how campers perceive short walk-in or boat-to campsites from a central developed complex; various materials used in path and tent pad construction; different kinds of campfire units, grills, toilets, and tables; various amounts or kinds of vegetative screening between campsites or between campsites and nearby facilities; various distances between the parking spur and the remainder of the site facilities; various facilities such as swing sets, horseshoe pits, hiking trails, and all sorts of interpretive materials.

Both camper populations and campground characteristics could be controlled for careful analysis. In past research we have investigated simply what was available rather than a mix of what *could be*. All participants would have to be thoroughly committed to the effort, and realize that some designs and ideas would not prove successful. After a reasonable study time, the campground could be opened to ordinary public use.

The returns both to campers and managers from cooperative ventures such as these could far exceed the financial and administrative costs. Not only would the public find a greater number and more enjoyable mix of campgrounds, but managers would achieve a better distribution of use and be able to counter social and ecological problems more easily.

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PHYSICAL SITE MANAGEMENT

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ABSTRACT.--Much information is available about the protection and maintenance of recreation sites, but the large number of resource variables and the highly specific nature of many research findings make it difficult to condense this information into a compendium of site management guidelines. Maximum use is apparently not being made of available site management information by recreation planners and managers. Reasons include the highly scattered nature of information, difficulty in obtaining pertinent material, and research findings not always directly applicable to the problem at hand. A proposal is made that site management information be computerized to provide periodic inclusion of new information and ready access of available material to all interested persons.

Recreational use of forest and wildland areas has grown quite rapidly and the rate of increase is expected to continue well into the future. From an estimated use of less than 10 million visitor-days on public lands in the late 1920's, it has grown to almost 450 million visitor-days in 1972. A further tripling of outdoor recreation demand by the year 2000 is forecast.

Such intensive use of forest and wildland areas for recreation creates overriding problems of how to make lands available to the public without impairing either the resource or the quality of the recreational experience. The ecological balance in forest and wildland environments is delicate, and where man returns frequently for prolonged periods of time, his direct impact on soils, vegetation, water, and forest beauty can be severe. Recreation site deterioration is a serious problem throughout the world. And it is not diminishing.

The approach that I have taken in the preparation of my paper is different from the usual one. Rather than rehash published site management information already available, I have interpreted my assignment as an opportunity to critically assess and to discuss with recreation planners and managers the status and applicability of available knowledge concerned with this important subject. My literature search included published research material from many sources, and recreation site management manuals, handbooks, and supplements of five Federal agencies which receive over 97 percent of all use which occurs on public lands.

I have not included a discussion of such important values as "esthetics" or "user satisfaction" but they are implicit, nonetheless, in all of my comments and recommendations. Coverage is not limited to the Midwestern situation. I have included material of a world-wide nature, on developed recreation sites and on general forest and wildland areas.

Great amounts of time, effort, and dollars have been spent in the past, are being spent today, and will likely continue to be spent in the future on the management problems of recreation sites. It did not take long after beginning the literature search to realize that one could easily be overwhelmed with published material and by the effort required to obtain it. The literature search yielded over 150 pertinent references and much additional material of only general or limited value. Additional material could have been requested. Several references date back 40 or more years, but most research and administrative studies have occurred since 1960. Several references were obtained from foreign countries. And research continues, as revealed by the large number of studies planned or in progress, especially at universities and at State Agricultural Experiment Stations throughout the Nation. An incomplete listing reveals 40 continuing or planned studies relating to site management.

A thorough study of the substantial pile of reference material received revealed a sizable and important obstacle

relating directly to the question of applicability. This obstacle was the extreme variability of site management problems and the highly specific nature of research studies and findings. Site and area conditions of most study locations have generally been highly variable in relation to soils, climate, topography, vegetation, levels of use, treatments, etc. The first 25 publications I looked at, for example, contained 76 different, major variables and conditions: from high elevation to low elevation, from thin soils to deep soils, from soil series AAA to soil series ZZZ, from wet to dry, from hardwoods to conifers, from high levels of use to low levels of use, from alpha to omega. The unique microconditions and macroconditions which existed from one study area to another seemed to have relegated most completed study efforts to case-history status. Specific cultural and remedial treatments, for site rehabilitation or maintenance, for example, that worked well under one specific stand condition, under one specific set of soil conditions, under one specific level of use, at one specific elevation, will likely not be directly applicable to locations having different conditions and characteristics. And these locations need not be very far apart. In the same watershed, treatments that worked well on east slopes might not work well on south slopes.

It was only after much agonizing and after spending an inordinate amount of time in the process that I realized that the variables and conditions involved in the physical and biological problems of site management were almost unlimited in number and that the pieces of this puzzle already contributed by research and administrative effort seemingly made up only a small part of the total big-picture puzzle and fit together only very loosely indeed. I began to wonder whether available information lends itself to direct and useful application by the majority of recreation planners and managers.

There was only one small, and perhaps inconclusive, check that I could make at this point to help answer my questions about the applicability of research findings. This was to determine, if possible, the use made of research findings by the five public agencies who supply a large share of recreational opportunity in the United States in the preparation of their site management handbooks, standards, and manuals. I found that the content and scope of recommended practices and procedures varied greatly between agencies, ranging from fairly complete and detailed instructions on certain aspects of site management, to almost complete freedom by field personnel in site management matters. I could not find a single reference in any of the material studied relating to specific research results or research publications. This is not to say, of course, that research results have not been used widely and effectively.

I am in no way faulting any of the excellent studies that have been completed. There have been many of them and they certainly contain a lot of valuable information. For example, in a series of recent studies relating to vegetation management on forested recreation sites: Echelberger (1971) found that well-maintained sites in the Adirondacks deteriorated little during the study period 1964-1969; Beardsley and Wagar in northern Utah (1971) found, among other things, that (1) good site design which includes planned routes for both foot and vehicular traffic and reinforcement of heavy-use areas can substantially reduce or eliminate deterioration of ground cover vegetation on new campgrounds, (2) watering, fertilizing, and seeding to durable species of herbaceous vegetation can effectively increase ground cover vegetation on sites under an aspen overstory, and (3) any site that is artificially watered should also be fertilized and seeded; and Magill (1970) attributed the increase of vegetation on five campgrounds in California to strategically located barriers and to greater precipitation during the 5-year study period.

Research findings such as these have undoubtedly been beneficial to recreation managers on whose sites and areas the research was conducted, and for the specific variables and specific conditions encountered. I am concerned, however, about the untold number of managers who, working perhaps only with very general site management guidelines, are also in urgent need of ready answers and sound guidelines, but on whose sites and areas the results of completed research do not apply directly.

The large number and great complexity of variables involved in site management may well preclude an effective solution by research alone. The piecemeal manner in which we have moved--on a site-by-site and

area-by-area basis--may never get the job done. The job would be staggering when one considers that the USDA Forest Service alone administers approximately 22,000 recreation elements (including water bodies), each of which needs protection and maintenance.

There is a very positive side to past research and administrative efforts, however, despite the fact that many pieces of the site management puzzle are missing and available pieces fit together only very loosely. Many general principles can be drawn from seemingly diverse results and conclusions, and available puzzle pieces can be separated into several piles of related subject matter. One pile consists of soil variables; one of site design and layout features; one of grasses, shrubs, trees, water sprinkler systems, and bags of fertilizer; and one of policy and regulatory and educational matters.

Soil pieces were the most abundant and occupied the center of the puzzle. Soil scientists, landscape architects, engineers, and others are in common agreement that the most essential element in the selection of potential areas for new site development, and in the management of existing sites, is a knowledge of soils and soil characteristics. "The state of knowledge about forest soils has reached the point that we can identify soils that are, or are not, suitable for recreation development, providing that the soil scientist knows for what purpose the soil is to be used" (personal correspondence, NFS, Region 8). Mackie (1965) states that the time is fast arriving when recreation planners will consider a soils map of recreation areas as essential as a topographic map.

The evidence indicates quite conclusively that one of the principal reasons for the widespread site degradation so prevalent today has been the lack of understanding by recreation planners and managers of the vital importance of soil and soil-related factors in the overall site management picture. Many recreational developments which are problem areas today were doomed from the beginning because they were constructed on soils poorly suited to recreational development and use.

The internal and external characteristics of forest and wildland soils are many and are highly variable. Soil interpretations by soil scientists, landscape architects, and engineers can provide information useful to recreation managers on all phases of site management. A preliminary, low-intensity soil survey made prior to a recreational development can yield such vital information as whether or not a given area is suitable for development; probable susceptibility of the soils to compaction, erosion, flooding, and landslides; and productivity potential and potential use capacities. If the area is deemed suitable for recreational development, or where changes in design are contemplated, a high-intensity soil survey permits interpretations to be made concerning the best locations for family units, buildings, roads and trails, parking areas, pond sites, filter fields, and others. In many cases, such a survey can yield information about fertilization levels and needs, and the vegetation species probably best suited to the site. It identifies fragile areas where recreation use should be restricted or where special reinforcement measures should be used.

The most useful type of soil survey information is the soil series. The soil series is a highly detailed fingerprint of the soil, and represents a large amount of accumulated knowledge which permits maximum interpretation and subsequent use by recreation planners and managers. Similar soil series react alike when used and treated alike, and interpretations made for specific soil series can be used wherever the series is found (Stevens 1966).

The cost of soil surveys is moderate, ranging from $2-$3 per acre for low-intensity surveys to $4-$8 per acre for high-intensity surveys, depending on soil complexity and the type and amount of information required. Systematic soil survey programs are being made by many Federal, State, and local agencies who will often furnish soils information free of charge. The Soil Conservation Service and cooperating agencies, for example, have been mapping soils and publishing detailed soil maps and reports for almost 30 years. They have recently compiled a classification of Wisconsin soil types and slope gradients according to the degree of limitations and restrictions necessary for successful recreation use without appreciable deterioration (Mackie 1970).

There is still much that must be learned about soils, but a good start

has been made. Major responsibility for the soils phase of recreation site management can likely best be handled by recreation planners and managers, and such agencies as the Soil Conservation Service. Little direct recreation research effort is probably needed. Continuing and careful observation by management of soil behavior under known levels and kinds of recreation uses can be expected to provide continuing improvement in site planning and design.

Site design and layout considerations are the next most prominent features of the picture. Numerous investigators have stressed the essential nature of good site design in site maintenance and management. Orr (1971) states that design is the number 2 variable in site deterioration. Design is one of the critical variables over which management has considerable control and which can be affected most easily. The relative success of the design and ground layout will determine how well a development provides for planned and desired uses within the capacity of the site to withstand them. Design is irrevocably related to maintenance. Poor design, even on good soils, can be expected to result in accelerated site degradation.

Based on the best possible estimate of carrying capacity for each planned site, most often a judgment factor, the development density of planned use must be controlled by the strategic location of facilities, by limiting the number of visitors, by design features which physically limit the number of persons who can occupy the site at any one time, and by site reinforcement measures. Careful placement of facilities, roads, and trails, for example, will direct users away from fragile areas and can significantly reduce deterioration. The fragile portions of sites should be avoided wherever possible or should be reinforced as needed by such materials as asphalt, gravel, sawdust, or soil cement. Barriers, such as fences, rocks, posts, and thorny plant material, should be placed in strategic locations to prevent or discourage unwanted use. Damage to site vegetation can be reduced by placing such things as picnic tables, tent pads, and fireplaces away from the feeding roots of shrubs and trees.

The puzzle becomes alive with grasses and trees and brightly colored shrubs. Besides being an essential element in site esthetics and visitor enjoyment, vegetation plays another major role; it is the best and most permanent method of erosion prevention and control. Of particular importance are grasses and herbaceous vegetation because this understory of vegetation promotes surface aeration and infiltration of precipitation. Vegetation, such as thorny plant material, can be used effectively to control foot traffic.

There is much that management can and must do to protect and promote vegetation on recreation sites and areas. Desirable vegetation of all types should be given maximum protection from physical damage by using sound site design features and reinforcement techniques and materials. Both native and exotic vegetation should be considered and used where appropriate. On many sites and areas it may be necessary to supplement or replace some of the existing vegetation with species better able to withstand impacts of use.

Much research effort has occurred in recent years on testing kinds and species of vegetation for use on recreation sites. There have been many successes and many failures. The failures have been due to several factors, some of which were the use of vegetation poorly adapted to the site, faulty planting techniques, insufficient or poorly timed maintenance, and the lack of protection for new plantings. Perhaps the principal reason for failure, however, has been the use of native and exotic species with little knowledge of the environmental conditions under which a seed parent grew or how a new plant would respond to a new habitat (Magill and Leiser 1972). Tough turf grasses should be encouraged wherever possible because they are generally able to withstand the impact of heavy use.

It is unlikely that utopia will ever be reached, but there are a number of important steps that can be taken. For one thing, recreation planners and managers must make greater use of soil survey information related to selection and use of vegetation better suited to specific site conditions. The site plan and field layout must fully integrate the vegetative component into the total site design so as to provide maximum protection to existing and planned vegetation. Testing of durable vegetative species which can be used over a wide range of environmental conditions should continue. Because of the size, com-

plexity, and cost of the task, however, it is best suited to cooperative attack by several agencies and groups. An excellent example of a cooperative research program in horticultural research is currently underway in California (Magill 1970). The program has drawn together the Department of Environmental Horticulture of the University of California at Davis, the Pacific Southwest Forest and Range Experiment Station, the Environmental Resources Branch of the U.S. Corps of Engineers, the Recreation and Wildlife Branch of the U.S. Bureau of Reclamation, and the Western Service Center of the National Park Service in an effort aimed at testing a wide selection of vegetative species over a wide range of sites and occasions. More such cooperative efforts are needed throughout the United States to supply needed information on a regional basis.

Good husbandry must be provided to the vegetative component of recreation sites. The payoff of sound protective and maintenance practices is amply documented in the large volume of available reference material. Insufficient or poorly timed maintenance are the reasons for much site deterioration which exists today. Recommended cultural and protection measures and practices include: fertilization, irrigation, mulching, shading of planted vegetation, chemical weed control, protection from mechanical injury and theft of small plants, and other treatments. Good site management should also include such silvicultural practices as thinning, improvement and harvest cuttings, removal of overmature and decadent trees, treatment or removal of diseased and insect-infested trees, pruning, brush control, and regeneration measures. Thinning of overstory is an especially important consideration in order to provide conditions favorable to tree reproduction and the development of ground cover species and turf grasses.

Continuing research is needed in cultural and silvicultural aspects of site management. It could be combined most effectively with a cooperative, regional program.

And now we come to the last pile of puzzle pieces. These pieces do not form the picture; rather, they form the border and hold it firmly together. The border represents control, regulation, education, and interpretation. All that planners and managers have accomplished, or will accomplish, in good site management will be for naught if sound control and regulatory measures are not formulated and vigorously enforced. In the face of deteriorating conditions we have often permitted overuse and abuse and have provided little or no enforcement of policy. Maintaining recreation use within the physical carrying capacity of a development must always remain a primary objective of management. Our recreation resource must be protected from overuse and abuse. New approaches and new concepts for handling visitors to our recreation sites and areas must be developed.

Educational and interpretive programs also play an important role in recreation site management. Somehow, somewhere, a viable action program must be initiated to develop greater appreciation and perception of the values of nature in our public.

I close with a brief summary and a proposal. Some deterioration of recreation sites is inevitable. Great mountains were reduced to peneplains long before man made his appearance on this good earth. But I think that the evidence is irrefutable that degradation of the Nation's recreation resource has occurred at a faster rate than it should have. There have been many faults and many ills, and numerous indicators that concepts of good recreation site management have not everywhere been applied. We must do better. We must give more than mere lip service to the basic elements of good site management revealed in our picture puzzle.

It does not appear that maximum use has been made of available site management information, possibly because the information was so scattered or was difficult to obtain, or that research findings were not always directly applicable to the situation at hand. Another important reason appears to be the tendency of field managers to disregard research findings. Instead, they seem to apply their own solutions to site management problems as they see them. One large recreation-oriented public agency, for example, does not provide any specific instructions that would tell the field manager how to do the job because they do not want to stifle individual creativity. The danger of this all-too-prevalent situation is clearly seen. Is there not a need to find ways of making research results more easily obtainable and of getting managers to better utilize site management information?

I am convinced that new research is needed and should continue on certain aspects of the site management problem. But I do not believe that this research should continue as it has been done in the past, on a site-by-site and area-by-area basis. This piecemeal attack on the problem cannot provide the greatest good for the greatest number.

I propose that the physical, biological, and social problems of site management be made a research, development, and applications program with many agencies, groups, and individuals participating, and aimed at the solution of regional, rather than local, problems. One of the first steps is to make a much more comprehensive literature search than was possible for me to make within the time constraints under which I worked. A wealth of untapped information exists, in Federal, State, and university research publications; in such Park Practice Program publications as Design, Grist, Guidelines, and Trends; in handbooks, standards, and manuals of public agencies; in circulars and bulletins from State Agricultural Experiment Stations; in administrative studies; in theses and dissertations, and from other sources. A limited amount of field observation and measurement of successful (but unreported) site management installations and practices, and discussions with experienced recreation site managers, would likely pay handsome dividends.

The information obtained as a result of the comprehensive literature search will be voluminous. The next step must be to condense and organize the material into a form that is useful and that lends itself to computer storage and retrieval systems, which will then provide ready access to all interested persons. A system similar to the U.S. Department of Agriculture's Current Research Information System (CRIS) or the INTREDIS Register used for data storage and retrieval in forest pathology (Hepting 1965) could be used. The data base could be updated regularly to include new knowledge as it becomes available. The results of this first effort in the proposed R, D, and A Program would undoubtedly surface many gaps in knowledge which would be expected to have a significant impact on future problem selection and orientation of the research program relating to physical and biological problems of site management.

The importance of good site management information warrants an in-depth effort to find ways to make current and future information readily and easily available to recreation managers and planners wherever they might be located and whatever might be their interest or problem.

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Stevens, Mervin E. 1966. Soil surveys as applied to recreation site planning. J. For. 64: 314-316.

SUGGESTED READING LIST

1. Bates, G. H.
   1935. Vegetation of footpaths, sidewalks, cart-tracks, and gateways. J. Ecol. 23: 470-487.

   The effects of grazing, treading, and puddling on the vegetation of footpaths, sidewalks, cart tracks, and gateways in Great Britain are investigated by quantitative and qualita-

tive methods. The effects of these influences on growth and survival of several species of grasses and plantains are discussed.

2. Brame, Robert H.
1962. Maintenance of picnic and camp areas. Seventh Annu. Southeast. Park & Recreation Train. Inst. Proc. 1962: 3-4.

This is a brief report concerning picnic and camp area maintenance and protection measures used on the John H. Kerr Dam and Reservoir in Virginia. Proper fertilization, well-planned and properly developed facilities, and use of native grasses are recommended.

3. Brockman, C. Frank, and Merriam, Lawrence C., Jr.
1973. Recreational use of wild lands. 2nd ed. McGraw-Hill, Inc., 329 p.

This is a generalized introductory text on recreation use of wild lands. Each of the chapters represents a skeletonized treatment of a particular aspect of the recreational use of wild lands. One chapter discusses the tools of the recreation planner and manager relating to physical/biological site management considerations.

4. Burden, R. F., and Randerson, P. F.
1972. Quantitative studies on the effects of human trampling on vegetation as an aid to the management of semi-natural areas. J. Appl. Ecol. 9(2): 439-457.

The authors outline the nature of the changes caused by human trampling in the soils and ground vegetation of semi-natural areas in Great Britain, discuss quantitative methods for relating these changes to the intensity of use, and suggest how these data might be applied in the formulation of management policies for recreation areas.

5. Byrne, T. G., and McNeely, G. H.
1965. Maintaining your lawns on heavy soils. Univ. Calif., Agric. Ext. Serv. OSA 92, 2 p.

The article discusses such cultural treatments as irrigation, fertilization, mowing, and weed control in maintaining laws on heavy soils.

6. Carey, John B.
1965. The use of soil survey in making engineering studies in recreation areas. Paper presented to Northeast Conserv. Eng., Northeast Fish & Wildl. Conf., Harrisburg, Pa., Jan. 19, 1965.

A knowledge of soil characteristics is useful in making engineering studies of recreation areas. Soil surveys contain considerable information about soils that can be used by planners in all fields. The key to this information is the soil series names which implies a unique set of soil properties to each soil.

7. Chan, F. J., Harris, R. W., Leiser, A. T., and Paul, J. L.
1969. Factors influencing depth of seeding. Tree Plant. Notes 20(2): 1-5.

The success of direct seeding of woody plants depends, in large measure, on the germinability of seed and environmental conditions in which the seed is planted. This paper discusses the influence of soil temperature, soil texture, and depth of seed placement on the emergence of three woody plant species in California having different-sized seeds.

8. Chan, Franklin J., Harris, Richard W., and Leiser, Andrew T.
1972. Direct seeding woody plants in the landscape. Univ. Calif., Agric. Ext. Serv. AXT n27 (3/72 rerun), 12 p.

Spot seeding of woody plants has been effective, economically feasible, and applicable

in differing terrains. This leaflet discusses the steps for spot seeding woody plants and includes a list of species tested to date that have good potential for success in California.

9. Colman, E. A.
1948. Soil surveying on wildlands: the problem and one solution. J. For. 46: 755-762.

Soil surveying has developed slowly on wildlands. The importance of such surveys has only recently been appreciated. The author presents suggestions for simplifying field and laboratory work so as to make wildland soil surveying yield the type of information most useful to the wildland manager. The soil survey of a southern California national forest is presented as an example of the application of these suggestions.

10. Countryside Commission.
1969. Picnic sites. 19 p. London: H. M. Stationery Off.

The report was prepared for those who are or will be concerned with the planning and management of picnic sites. It does not provide a detailed guide to the design of picnic sites, but rather collects together information from a variety of sources and suggests where more technical information can be obtained.

11. Darling, F. Fraser, and Eichhorn, Noel D.
1967. The ecological implications of tourism in national parks. Proc. 10th Tech. Meet. IUCN (Lucerne, 1966), Part I. IUCN Publ. (n.s.) Number 7, p. 98-103.

This report is a general discussion of the ecological implications of tourism in national parks. Ecological assessment of what is happening within national parks is growing as an art and a science, but is as yet insufficiently employed. The authors suggest that rather than channelizing visitation towards these areas, recreational areas of various kinds should be established elsewhere than in the national parks.

12. Davis, William B., Paul, J. L., Madison, John H., and George, Leon Y.
1970. A guide to evaluating sands and amendments used for high trafficked turfgrass. Univ. Calif., Agric. Ext. Serv. AXT-n113, 93 p.

The information in this report is the result of the first part of a continuing laboratory and field study on sands and soil mixes used in high traffic situations in California for the purpose of helping the turfgrass manager to make better informed decisions. The tables and graphs provide practical information that can be most useful.

13. Duncan, D. P.
1963. How to avoid picnic area deterioration. Park Pract. Guideline, Dev. 11: 67-71.

The author discusses the importance of careful site selection, proper design, and sound management practices in reducing deterioration of picnic grounds. In order to provide high-quality recreational sites and areas, managers and planners must use all available information relating not only to site management and maintenance, but also to original site selection and design.

14. Easterbrook, Arthur L.
1968. The effects of soil compaction on the occurrence of vegetatively reproducing plants in campsites. Thesis in partial fulfillment of MF, Univ. Mich. Sch. Nat. Resour., 90 p.

Study results revealed that soil compaction within camp-

sites is the major environmental factor which controls the occurrence and distribution of certain clonal plants; i.e., plants that reproduce vegetatively. The sensitivity to compaction of plants that reproduce vegetatively can be generally attributed to their shallow roots. Hence, it appears that vegetative reproduction is not a desirable asset for any herbaceous plant to possess within a campsite. Introduced grasses which reproduce vegetatively, however, are much more resistant and effective in counteracting the effects of trampling and/or compaction. In this study, bluegrass (*Poa interior*) and Fescue-grasses (*Festuca elatior* and *F. occidentalis*) were found to be quite resistant to heavy recreation use.

15. Edwards, R. Yorke
1968. The future of recreation on wild lands. For. Chron. 44 (3): 24-29.

The author discusses four measures which can alleviate a decline in the quality of wild rural lands: (1) developed facilities that are designed to limit the volume of use at that maximum level compatible with the preservation of wild values, (2) direct limitation of use at the level beyond which damage would occur, (3) restriction of the kinds of recreational uses most damaging to wildness, and (4) the use of interpretation programs to influence human behavior so there is an increase in the quality of recreational experience, accompanied by a decrease in the damage done by recreation.

16. Evans, George
1971. Tramp, tramp, tramp...testing turfgrasses. Now Mag. 8(1): 8-9.

This paper describes a study initiated during fall 1970 to test 38 different turfgrass species and varieties for their trampling and drought tolerance. The study will continue for 3 to 5 years and is expected to have significant application in improving turf cover.

17. Frome, Michael
1969. America's campgrounds are turning into slums. True Mag., April 1969, p. 32-36, 109-110.

A journalist's account of growing use pressures and the rapid degradation of campgrounds in the United States. The nature of many of the problems is discussed and several recommendations are presented for solution of the problem.

18. Gibbs, L. C.
1964. Fertilizing ornamental shrubs and small trees. Park Pract. Guideline, Maint. 12: 49-50.

The brief article presents a very general guide for fertilizing ornamental shrubs and small trees, including preparation of the soil for planting, time to fertilize, and fertilizer requirements.

19. Harper, John C., II
1964. Turfgrass fertilization of park areas. Park Pract. Guideline, Maint. 10: 41-44.

The author discusses fertilization of turfgrasses in recreation areas. Fertilization requirements are discussed for cool season grasses. The importance of liming in obtaining proper soil pH is stressed.

20. Harper, John C., II
[n.d.] Growing turf under shaded conditions. Pa. State Univ., Coll. Agric. Ext. Serv. Spec. Circ. 149, 1 p.

The circular recommends 16 maintenance and establishment practices which may improve the survival and growth of turfgrass under trees.

21. Harris, Richard W., and Davis, William B.
1967. Planting landscape trees. Univ. Calif., Agric. Ext. Serv. OSA 145, 2 p.

This brief report recommends establishment and maintenance practices for planting landscape trees.

22. Harris, Richard W., Hamilton, W. Douglas, Davis, William B., and Leiser, Andrew T.
1969. Pruning landscape trees. Univ. Calif., Agric. Ext. Serv. AXT-288, 29 p.

Pruning of landscape trees is an important practice for shaping and enhancing plants used in parks, gardens, and wildland recreation areas. This leaflet on pruning is primarily not a product of new research, but is a compendium of existing procedures and practices which can be used as a guide to capitalize on the natural characteristics of each tree species to add interest, beauty, and utility to the landscape.

23. Harris, Richard W., Leiser, Andrew T., and Davis, William B.
1969. Staking landscape trees. Univ. Calif., Agric. Ext. Serv. AXT-311, 13 p.
Staking to protect, support, or anchor young trees may be of considerable importance in recreational areas. This bulletin suggests different staking techniques for providing adequate, flexible supports for windy situations and reasonable protection of landscape trees with little or no injury.

24. Harvey, H. T., Hartesveldt, R. J., and Stanley, J. T.
1972. Wilderness impact study report. An interim report to the Sierra Club Outing Committee on the effects of human recreational activities on wilderness ecosystems. 87 p. San Francisco: Sierra Club Outing Comm.
This Interim Report primarily outlines the techniques which are being utilized to study the impact of Sierra Club trips on wilderness and other backcountry recreational areas. Research topics include: the effects of trampling on alpine vegetation; the availability, consumption, and production of firewood; the effects of packstock on meadow areas; and the disposal of human wastes and organic garbage. The report contains some preliminary comments based upon the evidence to date, and lists 36 tentative suggestions and considerations for reducing Sierra Club outing impact.

25. Howard, Gene S.
1972. Plants for problem areas of the western States. Yearb. Agric. 1972, p. 154-167.

The paper discusses factors affecting plant growth in problem areas of the western States and lists over 250 plants suitable for planting, classified by zones according to average annual minimum temperature, annual rainfall, soil pH, and other factors.

26. Hutchison, S. Blair
1962. Recreation opportunities and problems in the national forests of the northern and intermountain regions. Intermt. For. & Range Exp. Stn., U.S. For. Serv. Res. Pap. 66, 34 p.

This paper describes the recreation situation and opportunity on the national forests within the territory of the Intermountain Forest & Range Experiment Station and identifies the principal problems relative to recreation use. Most of the publication relates to the development of management measures to prevent deterioration of recreation sites and areas. The discussion is relevant not only to national forests of the Northern and Intermountain Regions, but equally as well to all regions of the United States.

27. Jemison, George M.
1967. Impacts of recreation on the ecology of temperate North American forests. Proc. 10th Tech. Meet. IUCN (Lucerne, 1966), Part I. IUCN Publ. (n.s.) Number 7, p. 173-185.

The author discusses the impact of recreation on the ecology of temperate forests in North America. He states that recreation planners and managers are fortunate to have a fund of knowledge to help cope with recreation and its social and biological impacts on the environment, but states that in most cases this fund is only the plateau upon which research must build.

28. Keet, B. J.
1968. Recreation and our soil. Farming in South Afr. 43(12): 75-77.

South Africa only recently joined the field of outdoor recreation. The brief article discusses the importance of protecting the soil of South Africa, not only because of its agricultural and economic potential and value, but also for its recreational potential. The South African Department of Sport and Recreation promises to do everything within its power to promote public consciousness of the theme "Soil is Life."

29. Kraus, O.
1967. Ecological impact of products of tourism and recreation on the countryside adjacent to highways. Proc. 10th Tech. Meet. IUCN (Lucerne, 1966), Part I. IUCN Publ. (n.s.) Number 7, p. 160-169.

The author presents a very general treatment of the ecological impact of tourism and recreation on the countryside adjacent to highways, and recommends regulation and control to reduce the severity of such impact.

30. Kurmis, Vilis, and Hansen, Henry L.
1969. Occurrence and distribution of pine reproduction in Itasca State Park, Minnesota. Minn. For. Res. Notes 210, 4 p.

This report deals with advance pine reproduction in Itasca State Park in Minnesota. It analyzes the relationships between mother stands and forest types using the synecological coordinate method. The authors conclude that without major disturbance or special silvicultural measures the present area of pine-dominated stands in the park will continue to decline.

31. Lindsay, John L.
1969. Locating potential outdoor recreation areas from aerial photographs. J. For. 67: 33-34.

This study correlated standard photo interpretative techniques with seven criteria for identifying recreation land of high potential. They were population center factors, land use, water value, road systems, vegetation, aesthetic value, and unique features. All but the last two were consistently useful for recreation potential prediction. Seven scales of photography were tested using the criteria named. The 1:12,000 scale proved most effective. The results indicated that aerial photographs can be used effectively to locate potential outdoor recreation sites.

32. Magill, Arthur W., and Leiser, Andrew T.
1972. Growing plants on view landscapes and recreation areas. Guideline 2(5): 57-61.

A substantial cooperative horticultural research program is underway in Cali-

fornia to develop effective solutions to problems of plant establishment and maintenance on difficult recreation sites. The program has drawn together the Department of Environmental Horticulture of the University of California at Davis, the Pacific Southwest Forest and Range Experiment Station, the Environmental Resources Branch of the U.S. Army Corps of Engineers, the Recreation and Wildlife Branch of the U.S. Bureau of Reclamation, and the Western Service Center of the National Park Service. The cooperative research effort is developing a valuable storehouse of information that can be effectively used by resource managers to establish and maintain vegetative cover on a variety of developed site and visually sensitive areas.

33. Magill, Arthur W., and Twiss, R. H.
1965. A guide for recording esthetic and biological changes with photographs. Pacific Southwest For. & Range Exp. Stn., U.S. For. Serv. Res. Note PSW-77, 8 p.

Photography has long been a useful tool for recording and analyzing environmental conditions. Permanent camera points can be established to help detect and analyze changes in the esthetics and ecology of wildland resources. This note describes the usefulness of permanent camera points and outlines procedures for establishing points and recording data.

34. McCall, Wade W.
1969. Learn to interpret your soil test results. Univ. Hawaii, Coop. Ext. Serv. Circ. 432, 11 p.

This circular discusses the meaning of such soil tests as pH, available phosphorus, potassium, calcium, and magnesium, salinity, and water, and discusses liming and fertilizer requirements.

35. McCall, Wade W.
1970. What's in that fertilizer bag? Univ. Hawaii, Coop. Ext. Serv. Circ. 441, 19 p.

The author presents a concise treatment of the fertilizer elements essential for plant growth and lists the average composition of 55 fertilizer materials.

36. McCurdy, Dwight R., and Johnson, Larry K.
1967. Recommended policies for the development and management of State park systems. South. Ill. Univ., Sch. Agric. Publ. 26, 34 p.

This report contains 24 recommended policies for the development and management of State park systems, based on a thorough review and analysis of the existing policies of 39 State park systems in the United States.

37. Meskimen, George
1970. Combating grass competition for eucalyptus planted in turf. Tree Plant. Notes 21 (4): 3-5.

Using cleared planting spots and fertilizing frequently, 1-year-old quart-potted seedlings of *Eucalyptus camaldulensis* can be converted into an established sapling 15 feet tall with a 3-inch-diameter trunk, and in 2 years the tree can be a major element of the landscape.

38. Meyer, L. D., Johnson, C. B., and Foster, G. R.
1972. Stone and woodchip mulches for erosion control on construction sites. J. Soil & Water Conserv. 27(6): 264-269.

Mulches of crushed stone, gravel, and wood chips showed great potential for erosion control on construction slopes. Soils covered with 1 inch of stone mulch were much less erodible than those with more than 2 tons per acre of straw. Heavier

rates of stone or 1-1/2 inches of wood chips were even more effective. Good to excellent stands of grass were obtained on many of the stone and wood chip treatments following erosion tests. The study was conducted on a 20-percent borrow-pit sideslope with slope lengths up to 150 feet.

39. Montville, Francis E.
1968. How to plan the recreation enterprise. Univ. Maine, Coop. Ext. Serv. Circ. 396 (revised), 12 p.

This booklet provides a framework for individuals interested in developing a recreational enterprise. A step-by-step approach is given for obtaining pertinent information needed for guidance in the development of a successful income-producing recreation enterprise.

40. National Industrial Pollution Control Council
1971. Land and water pollution from recreational use. NIPCC Sub-Counc. Rep., Dec. 1971, 24 p.

This is a progress report on land and water pollution resulting from recreational use. It contains several major recommendations, and describes related pollution problems and what industry is doing about them.

41. Oliver, Craig S.
[n.d.] Ground cover...nature's garden carpet. Pa. State Univ., Coll. Agric. Ext. Serv. Spec. Circ. 108, 16 p.

Grass is the best and least expensive ground cover, but there are places where it does not grow satisfactorily and is difficult to maintain. There are several typical locations--shady locations, steep banks or slopes, areas where tree roots protrude above the soil surface--where low-growing shrubs, vines, and herbaceous plants are better suited than grasses for landscape purposes. The circular describes approximately 100 plants that are suitable for specific locations and situations in Pennsylvania and surrounding States.

42. Orr, Howard
1971. Design and layout of recreation facilities. *In* Recreation symposium proceedings. USDA For. Serv., Northeast. For. Exp. Stn., p. 23-27.

Design of recreation facilities is the number 2 variable in site deterioration. Its relative success will have much effect on how well a development provides for the desired uses within the capability of the site to withstand them. It must be as accurate a solution to the development problem as possible. Design and layout of facilities must be a problem-solving process and one that requires highly analytical and creative capabilities.

43. Partain, L. E.
1966. Use of soils knowledge in recreation area planning. Va. Polytech. Inst. Ext. Bull. 301, p. 180-184.

Research and experience have shown the close relationship between different kinds of soil and their soil and water management problems and production potentials. A soil map properly interpreted can be very useful in selecting and planning sites for camping activities. A useful table is included which shows limitations of sites for camping activities based on drainage characteristics of soils.

44. Rickman, R. W., Letey, John, and Stolzy, L. H.
1966. Compact subsoil can be harmful to plant growth. Parks & Recreation 43 (2): 334-335.

In a large number of naturally occurring soils, claypans and heavy subsoils form a dense layer beneath the soil surface. Most plants grow very poorly in this situation. Drilling 2- to 3-inch diameter holes at close intervals to allow better root development will be beneficial for normally deep-rooted ornamental plants in recreation areas.

45. Rudolf, Paul O.
1967. Silviculture for recreation area management. J. For. 65: 385-390.

The importance of the forest in providing outdoor recreation has been recognized for a long time, but management of the forest for that purpose often has had to take a back seat. Cultural practices for producing and tending forests usually can be so applied and so modified as to provide, maintain, or improve recreational values. The author describes some ideas on how silvicultural practices can be used for developing recreational areas.

46. Saito, K., and Tachibana, H.
1969. Influences on human impact of forest vegetation in Japan. I. Changes in forest vegetation and soil due to impact in Sendai Area, Miyagi Prefecture, northeast Japan. Ecol. Rev. 17(3): 131-152.

Few intensive researches have been made on the dynamics of the forest ecosystem caused by human impact. The writers' aim was to reveal the causal relation between the vegetational and environmental changes of the forest induced by the increasing impact of man. The first attention is focused on the changes of the vegetation and the soil in the course of retrogressive succession from the climax forest to the secondary one.

47. Stankey, G. H., and Lime, David W.
1973. Recreational carrying capacity: an annotated bibliography. Intermt. For. & Range Exp. Stn., Tech. Pap. (In press).

This publication contains almost 200 annotated references pertinent to carrying capacity decisionmaking. The contents of the bibliography are arranged into four parts: (1) the concept of carrying capacity, (2) biological investigations of recreational carrying capacity, (3) investigations of aesthetic carrying capacity, and (4) managing for recreation carrying capacity.

48. Steiner, Wilmer W.
1972. Gardening to help solve your erosion problems. Yearb. Agric., 1972, p. 9-16.

Selecting proper plants, choosing the best ways to get them established, and then deciding on treatment measures for long-term management of the protective vegetation are all-important steps in developing and maintaining erosion-resistant vegetative cover. The article includes a brief discussion of techniques for vegetative management, and advises that persons and agencies having conservation problems should seek local help from soil conservation districts or from Soil Conservation Service and Extension Service offices.

49. Stone, Oscar P.
1967. Tree care with liquid feeding needles. Trees Mag. 22(6): 14-15.

The author discusses the use of liquid feeding needles in conjunction with hydraulic sprayers in feeding trees. With modern developments in water-soluble fertilizers, the use of this method of plant invigoration and nourishment has become a great

help in keeping trees, shrubs, and flowers in more active growth. The addition of systemic insecticides to the fertilizer mixtures will more easily control scales, aphids, leaf miners, and other hard to control insects.

50. University of California, Department of Environmental Horticulture
1971. Establishment of woody plants by direct seeding in California. Coop. Publ. U.S. Dep. Transp. Fed. Highw. Adm., Bur. Public Roads & Calif. Dep. Transp., Div. Highw., Highw. Res. Rep. July 1971, 81 p.

This bulletin characterizes some of the site problems associated with landscape planting of woody plants in areas of low rainfall in the Southeastern United States. The main findings of 3 years' laboratory and field studies was that direct seeding of perennial plants offers the possibility of low initial investment and minimum maintenance. The report describes seed handling and planting procedures, presents results of representative planting trials, and lists species that have been found satisfactory for specific situations.

51. USDA Agricultural Research Service
1962. Understanding soil compaction. Agric. Res. 11(2): 7.

Results of USDA experiments by ARS soil scientists to determine why plant root growth is restricted or halted by layers of compacted soil revealed that root growth slowed or stopped only when the soil had so much resistance to penetration (strength) that roots could not force a passage. The information will be useful in designing tillage systems for soils where compacted layers are a problem.

52. USDA Forest Service
1962. Working drawings of basic facilities for campground development. Agric. Inf. Bull. 264, 23 p.

This bulletin contains self-help suggestions and a set of working drawings of basic facilities for campground development intended to aid the landowner in planning, building, and maintaining the basic facilities for a family forest campground or picnic area as a private business venture.

53. USDA Forest Service
1965. The American outdoors--management for beauty and use. Misc. Publ. 1000, 76 p.

The U.S. Department of Agriculture has been steadily developing useful ways and means for maintaining and restoring the natural beauty of outdoor America. This booklet outlines some of the approaches to beautification along with use of the land. It also lists sources of further information and technical assistance.

54. USDA Forest Service
1970. Soil survey procedures handbook - 2509.14, p. 55.24--1(2) - 55.24--17. *In* For. Serv. Handb. R-8 Suppl. 1.

This Region 8 Supplement to USDA Forest Service Soil Survey Procedures Handbook (FSH 2509.14) describes procedures for the application of soils data in recreation resource programs. Detailed procedures are outlined for preparing a Stage 1 Soils Report prior to land acquisition when primary justification is for recreational development, and a Stage 2 Soils Report in recreation design for all existing sites as changes in design are contemplated and on all proposed recreation development sites.

55. USDA Forest Service
1973. Recreation management - 2300, p. 2331.1--1 - 2331.1--9. *In* For. Serv. Man. R-2 Suppl. 62.

This Region 2 Supplement to USDA Forest Service Manual 2300 describes the procedures to be used when preparing recreation site plans. A detailed description is given of the content requirements of each site plan, and includes: (1) narrative design report, (2) detailed site map, (3) preliminary design concept, (4) general plans, and (5) final construction plan.

56. USDA Soil Conservation Service
1966. Guide to making appraisals of potentials for outdoor recreation developments. 72 p.

The purpose of this guide is to provide a systematic approach to appraising the potentials for future outdoor recreation development in an area the size of a county or small group of counties. It can be adapted to areas such as watersheds or trading areas of similar size. The information provided and the conclusions reached are useful in recreation programing and planning by soil and water conservation districts, counties, and by agencies working in such areas.

57. Van Dersal, William R.
1972. Adventures with native plants that passed their 'tests.' Yearb. Agric., 1972, p. 176-184.

The author discusses several important management practices for growing native plants in gardens. Also included is a partial listing of trees and shrubs considered by gardeners and horticulturists to be the very best for various parts of the United States.

58. Volk, Gaylord M.
1964. Know your fertilizers. Univ. Fla., Agric. Ext. Serv. Bull. 177A, 25 p.

This bulletin presents a discussion of the information found on the tag attached to containers of fertilizer. The author stresses the fact that an understanding of the information found on fertilizer tags can often prevent needless expenditures for materials containing unnecessary elements, or crop losses resulting from the use of materials lacking in some essential plant food.

59. Walker, Laurence C.
1964. Fertilizing shade and forest trees in parks. Park Pract. Guideline, Maint. 11: 45-47.

This article describes procedures for applying dry and liquid fertilizers to established shade and forest seedlings, sapling and larger trees, and recommends practices for fertilizing trees at the time of transplanting.

60. Youngner, Victor B., Madison, John H., and Davis, William B.
1966. Which is the best turfgrass? Univ. Calif., Agric. Ext. Serv. AXT-227, 2 p.

The circular evaluates 12 popular varieties of common turfgrasses for 14 important characteristics and requirements.

RECENT DEVELOPMENTS IN LANDSCAPE ASSESSMENT RESEARCH WITH IMPLICATIONS FOR MANAGING FOREST LAND FOR RECREATION

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ABSTRACT.--Several recent studies in psychophysics, forest aesthetics, and landscape assessment are reviewed which suggest that forest vegetation can be managed as a visual resource. On flat and undulating land, as found along the Great Lakes and Atlantic seaboard, the visual interest in the landscape depends largely upon the distribution of open and forested land. Patterns of open and forest land are considered that would enhance the visual interest and spatial variety on flat, forested land for those recreational activities involving movement through the landscape.

INTRODUCTION

The importance of managing forest vegetation for its visual amenities has been recognized by the Forest Service, and has received particular attention over the past several years (USDA Forest Service 1973). An appreciation for the visual composition of wooded environments is deeply rooted in western civilization, and the tradition of managing vegetation as an object of enjoyment is well established (Zube *et al.* 1971).

The visual qualities of forest landscapes are sources of stimulation and enjoyment in a recreational environment. The visual content and composition of the physical environment influence the recreation experience, and where recreation is the predominant use of forested land, the visual qualities of the land and the vegetation can become an important recreation resource. However, the particular aesthetic attributes of forest vegetation are complex and elusive, and difficult to describe and evaluate in terms that persons of diverse backgrounds and sensitivities can agree upon.

This paper will review several recent research efforts which seem to have implications for managing forests as visual recreational resources. Several research efforts in the areas of perceptual psychology and psychophysics have been directed at understanding the mechanism by which the visual environment is perceived. Also, several models have been recently developed by landscape planners to inventory and evaluate visual quality over broad regions for the purpose of reserving recreational resources and predicting change resulting from future development. The recreational activities most affected by the visual qualities discussed here are those activities in which people are moving through the landscape and experiencing sequences of spaces and views as they do while riding, walking, or boating.

RELEVANT STUDIES IN PSYCHOLOGY

Several investigations in visual perception and behavioral psychology point to certain abstract elements in preferred scenes which can be measured and quantified. Such measurable abstract elements could be used as a basis for inventorying and evaluating visual resources.

One psychological study (Mackworth and Morandi 1967) sets out to determine whether adults looking at a pictorial display sought out certain dominant details, and whether it mattered at all where they focused their eyes when viewing a picture. The study concluded that the highly repetitious, smooth-textured elements were overlooked in favor of the less frequent and unusual details in the pictorial display. In other words, adults are very specific in what they focus upon and, furthermore, they are consistent in the particular elements which they focus upon. Attention tends to be directed to the edges between contrasting even-textured surface areas in photographs. The eye movement recorder used in this study measured the rapid shifts in eye fixations and accurately described the points in the pictorial display that the eyes fixed upon momentarily.

The eye-movement phenomenon reported by Mackworth and Morandi was explored further by Gratzer and McDowell (1971) who used black-and-white photographs of forest scenes, five of them taken of National Forests, and five taken of scenes in the rural Connecticut countryside. Gratzer and McDowell's study showed, as expected, that the eye fixated most often along

edges--along shoreline, skyline and ridgelines, along lines separating distinctive vegetative types (as between pasture and woodlot) and along the edges of strong shadows. In certain photographs a few fixations occurred on small objects that stood out from the background--a snag amidst even-textured foliage, or a bright patch of grass amidst dark foliage.

This study suggests that in forested settings attention is focused on the edges between large, contrasting, even-textured masses, or on small, outstanding objects. The eye does not wander within large, even-textured masses but rather the eye concentrates upon the edges between contrasting masses of even texture and on a very few small but outstanding visual elements.

Eye movement studies do not appear to give any indication as to the observer's preference, nor do they suggest how the observer evaluates the content of the scene. Eye movement studies do show that attention is attracted to abstract features, such as edges, and particularly those edges between a few, contrasting masses and forms. The eye skips over the commonplace, the redundant elements to single out a few singular, distinctive elements.

Another germane avenue of psychological research is that of stimulus complexity and exploratory behavior pioneered by Berlyne (1960). Berlyne maintains that complexity increases with the number of distinguishable elements, that complexity increases with dissimilarity between elements, and that complexity varies inversely to the extent that several elements are perceived as a unit. Berlyne, investigating the relation between complexity level and human preference, has found that with increasing levels of complexity preference increases also, but beyond a critical level of complexity, preference decreases.

Wohlwill (1968), investigating some of Berlyne's concepts, related complexity in the visual environment with the preferences of individuals. The results seem to substantiate Berlyne's theories. Two sets of photographic slides, one set of landscape scenes, another of abstract paintings, were scaled according to their complexity. Complexity was rated as to color, directions of dominant lines, texture, shape, and artificiality. As expected, preference increased with increasing levels of complexity up to a point beyond which preference decreased. The particular critical point in complexity appears to vary among individuals depending upon their familiarity with the visual environment and other factors. However, the concept is intriguing when considering the evaluation of forest landscapes for their visual interest.

These three studies indicate that certain abstracted, visual elements in forest settings might serve as a basis for estimating the visual interest of forested settings.

A MODEL OF SCENIC PREFERENCE

Several studies by Shafer of the Northeastern Forest Experiment Station have identified a few quantitative variables in wildland scenes of high scenic quality which substantially account for the scenic preferences of wildland recreationists in New York State and Utah (Shafer *et al.* 1969, Shafer and Mietz 1970). The relevance of Shafer's model to landscape management lies in the importance it attaches to the edges and the area of water, massed vegetation, and exposed ground as a measure of visual appeal and interest.

A photograph was divided into three distance zones (immediate, intermediate, and distant). Then measurements were taken in each distance zone of the perimeter and area of such elements as vegetation (trees and shrubs), nonvegetation (grass, bare soil, and rock), and water. A mathematical model containing certain combinations of the perimeter and area measurements provided an estimate of the preferred visual quality of the photographed scene. Through factor analyses, the following measurements were found to contribute to a high preference rating: (1) perimeter of immediate vegetation, (2) perimeter of intermediate nonvegetation, (3) perimeter of distant vegetation multiplied by area of water, (4) area of intermediate vegetation multiplied by area of distant nonvegetation, and (5) area of intermediate vegetation multiplied by area of water. The predicted preference score obtained from measurements on the photographs was compared to the actual preferences expressed by campers in the Adirondacks for the same photographs. The predictive model explained 66 percent of the variance in camper preference. Similar results were obtained when the preferences of hikers in the Wasatch Mountains of Utah were compared with the model's predictive score; again 66 percent of the variance in preference was explained.

Shafer's model, based upon measurement of edges and areas of visual forms on photo-

graphs, provides a convenient estimate of scenery preferred by wildland recreationists. It can be used in planning new facilities to predict preferences at given locations. It can also be used to study the visual elements in a given scene which contribute to its preference rating.

A LANDSCAPE CLASSIFICATION MODEL

There is one other thread to be woven into this discussion before we consider the visual aspects of forest management practices. That is the relative importance of landforms and forest vegetation. One basis for estimating the relative importance of forest vegetation as a visual resource is provided by Zube's model for classifying and evaluating landscapes on a regional basis (Reg. Plann. and Design Assoc. 1970). This model recognizes landform as the most fundamental visual criterion for classifying areas within a broad region.

Zube classified the landforms of the North Atlantic region as mountains, steep hills, rolling hills, undulating land and flat land, depending upon the relative relief between valley floor and ridgelines over large areas of 100 square miles or more. Landforms are an appropriate basis for classification because they are the most permanent and enduring visual elements in the landscape. Landforms determine the course of streams, and the contours of natural and artificial bodies of water. Dominant landforms--mountainous and hilly terrain--define major spaces and provide elevated vantage points from which to view broad expanses of landscape. Areas of less dominant landforms--undulating and flat lands--are less visually interesting as they do not have broad vertical elements to define major spaces, or elevated vantage points to provide wide and distant views.

The landscape classification model further subdivides the land within each landform class according to the pattern of surface elements on the land. The three elements which are considered to be visually significant are:

(1) open land - fields, pasture, marsh,

(2) forested land - forest, woodlots, and

(3) urbanized land - containing clusters of buildings and other man-made structures.

The landscape classification model provides a basis for rating the relative importance of forest vegetation as a determinant of scenic quality in areas where landforms are less dominant, such as the land Zube classifies as flat and undulating. Flat and undulating landforms are characteristic of the heavily urbanized North Atlantic seaboard, and also much of the land surrounding the Great Lakes.

IMPLICATIONS AND APPLICATIONS

Let us consider, for a moment, forest vegetation strictly as an object to be managed for its visual interest in recreational settings. The eye-movement studies suggest that some monotonous landscapes might be made more visually interesting by creating more edges and providing masses of contrasting tone and texture. Since vegetative patterns are most easily manipulated, an increase in the number of exposed edges between forest land and open fields or water should enhance scenic quality. Yet Berlyne's research suggests that there may be a limit to the extent by which edges can be increased without impairing scenic interest.

Assuming that on flat and undulating land the visual interest in the landscape largely depends upon the variation in vegetative cover, the following examples illustrate how forestation and clearing of forest land might affect the scenic interest of the landscape.

The findings of the studies discussed so far would suggest that in rural land with relatively flat terrain, the distribution of forested land and open land would largely account for whatever visual interest there was in that landscape. Open land is here defined as land devoid of tall trees, and would include fields, pastures, clearings, marshes, and water surfaces. Forested land is defined as continuous tree cover.

Consider a situation where terrain is covered with low vegetation, grasses, or other herbaceous cover. The view of a person standing in such a landscape is unobstructed in all directions and most of the visual interest lies in whatever pattern may occur on the ground below him and extending up to the horizon.

Suppose blocks of forest vegetation were added to this open landscape. Edges between wooded tracts and open land provide strong visual contrasts that attract attention. Spaces are defined by the vertical masses of trees. The view to the horizon is partially obstructed, and the visually constraining blocks of forest

vegetation define major spaces in much the same way that mountain and hill landforms shape spaces and vary the distance one can see in certain directions. Even recognizing that blocks of trees are not substitutes for hills and ridges, it would be reasonable to expect that by introducing distant blocks of trees onto otherwise open, flat land, the scenic quality would be enhanced.

Now take a situation on the other extreme, where flat terrain is under continuous forest cover. A person standing within the forest can see only a short distance in any direction. The space is extremely confined by tree trunks and the overhead canopy. There is little contrast in visual forms to create edges. However, where clearings occur as breaks in forest cover, edges are created. Strongly defined major spaces will result. They are similar in their visual effect to the spaces shaped by mountains and hills. Masses of trees provide the steep vertical walls that confine the view. The swath cut through the forest for a road resembles a canyon carved into bedrock. The sloping profile at the edge of a clearing where tall trees blend into tall shrubs, low shrubs, and herbaceous growth, appears much the same as the profile of a steeply sloping hill.

On flat and undulating terrain, steeper landforms can be simulated by structuring vegetation of varying height and growth forms. Likewise the relief of flat and undulating landforms can be exaggerated by maintaining a high profile of forest vegetation on the rises and ridgelines and by keeping most of the flood plains and valley bottoms relatively open. The natural drainage pattern might well serve as a basis for organizing spaces of open land bounded by forest. Sequences of spaces of varying dimensions could provide a more stimulating visual recreational environment, particularly for persons moving through the forest-defined spaces.

The distribution of forest vegetation and open land can also be considered in terms of visual complexity. Level terrain with a highly diverse spatial organization of blocks of trees and open land of varied sizes and dimensions can be extremely complex and disorienting to some people; or conversely level land that is entirely forested or entirely open can be simple, predictable, and perhaps boring to others. Although further studies of recreationists' responses to complexity of spatial organization on forested sites are needed, some intuitive consideration for spatial complexity can be given when planning and designing sites for forest recreation.

There is justification for managers of forested recreation sites to consider forest vegetation as a visual resource, and as an object to be manipulated for its visual stimulation. Native trees, shrubs, and herbaceous vegetation might well be manipulated to vary the visual interest and stimulation they might afford to recreationists as they pass through rural forested environments.

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Research Planning and Design Associates, Inc. 1970. Visual and cultural environment. North Atl. Reg. Water Resour. Study - Append. N. 279 p., illus. Amherst, Mass.

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VISUAL VULNERABILITY OF FOREST LANDSCAPES

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ABSTRACT.--Broad land-use planning, preparation of environmental impact statement, and detailed multiple-use planning all need to recognize that the visual landscape will be altered by physical results of management decisions. Certain landscape characteristics can be used to predict vulnerability or resistance to visual impacts of man-made changes, such as roads or timber harvest. For planning and design purposes, impact prediction needs to precede detailed knowledge of what the impacts themselves may be. Sources of visual landscape vulnerability or resistance are related to (1) landscape compositional types, (2) sensitive parts and locations found in landscape, and (3) outside influences and inherent effects, such as orientation, climate, seasons, slope and soil and vegetation surfaces. Some rankings on levels of visual vulnerability are posed.

This paper suggests a way to predict, or at least to anticipate, where a landscape will be visually vulnerable or resistant to change, identifies some sources of visual vulnerability, and ranks the levels of vulnerability for some of the more sensitive parts of the landscape.

SOURCES OF VISUAL VULNERABILITY

Landscapes include a vast array of variable components and characteristics. Therefore, it is not easy to say with finality why some landscapes are more sensitive to visual impacts than others. However, three sources of visual vulnerability can be identified in the landscape itself: (1) the presence of distinctive landscape compositions (types), (2) sensitive parts and locations, and (3) outside influences and inherent effects. Within these sources a range of sensitivities will be encountered.

Considering what in a landscape makes it more vulnerable or less to visual impacts involves the same factors that I have used in making scenic analyses and landscape inventories (Litton 1968, 1972; Craik 1972). Developing an inventory of the landscape is necessarily the beginning of a selective and evaluative procedure. And the concern for visual vulnerability may be considered a special category of landscape analysis and inventories.

LANDSCAPE COMPOSITIONAL TYPES

Landscape types are conspicuous visual compositions which display high (or distinguishable) levels of esthetic quality. As these occur, greatest visual vulnerability should be expected. Such types are composed arrangements which have, in esthetic terms, unity, vividness, and variety (Beardsley 1958). In the landscape, one kind of unity is that of a dominant landform with coordinated, subordinated, surrounding parts. Vividness can be expressed by contrasts of elements such as color, line and shape. Variety (or richness) is usually that of numerous and different parts seen together. All of these conditions found joined to form specific landscape types will be in nodes (Appleyard *et al.* 1964) rather than being the continuum of more usual open space surroundings which I call the "ordinary" landscape.

Ordinary landscapes lack the distinction of landscape compositional types, and we tend to take them for granted. Normally extensive, their major value is in a regional integrity or unity. Yet they are apt to lack the significant variety and vividness expected in the landscape types. In Beardsley's words (1958), they are characterized by "indifferent differences." Ordinary and distinctive landscapes complement one another and together make the whole landscape.

Visual vulnerability is less obvious in ordinary landscapes than in distinguished landscapes. But impacts of degradation, after slowly accumulating, can be just as devastating. This impact suggests that visual vulnerability is of two kinds--that which is immediately obvious and that which occurs slowly, developing over time.

Several selected landscape types such as feature, enclosed, and focal landscapes, will illustrate more specific sources of visual vulnerability (Litton 1968).

Feature landscapes are built upon such readily identified elements as a dominant landform; for example, an obvious water display, such as falls, or a specific part of vegetative cover, such as a significant grove or cove of trees. Or these conspicuous expressions of terrain, water, and plants may be found together. Visual contrasts giving particular definition to features--but to other landscapes as well--can include dissimilarity from surroundings (apparent isolation), significant scale differentiation, contour distinction of earth-sky silhouette, water surfaces, and edges against terrain or vegetation. These kinds of contrasts or sources of vividness which demand our visual attention also explain why the potential for visual vulnerability is high. Additionally, a landform feature (and other terrain faces) may be given distinction by such surface variations as a mosaic pattern of vegetative cover. However, a complex surface pattern can also hide and obscure alterations so as to reduce visual vulnerability.

An enclosed landscape, another positive compositional type, is an expression of limited, three-dimensional space. It can typically be represented by a named valley, with well defined encircling walls and clean cut bottom. Distinction lies in the simple unity of the composition and particularly in the nature and proportions of walls and bottom. Visual vulnerability will be highest in relation to the walls and their surfaces, and also to the junction between the floor and walls. The threat is to break or detract from the ring-like compositional structure.

A focal landscape, one kind being a straight segment of a riverscape, draws and focalizes attention. A series of essentially parallel lines appear to converge toward a point or terminal area in the distance. The area of focalization is the most vulnerable part of the composition since attention is directed there. The parallel lines are those of water-land edges, riparian borders meeting upland vegetation, and perhaps banks or cliffs carved by stream erosion. Breaking and disrupting these lines is a secondary source of visual vulnerability.

Because the landscape types are readily identified compositions and they tend to contain esthetic quality in good measure (Craik 1972), they are especially vulnerable to visual impacts. The threat is to their special lines, surfaces, and proportions and eventually to the completeness and stability of their composition.

Sensitive Parts and Locations

Some parts of the landscape or locations upon it will be recognized as more sensitive to impacts than others. Edges--visual junctions of parts--are especially vulnerable to disruptions. Different locations--identified as places higher or lower in the landscape--will show different levels of sensitivity to impact. Rankings of vulnerability are suggested for some selected edges and locations.

Edges--Ranked for Vulnerability

(3) Ridgelines separated in space and viewed against the background foil of more distan land surfaces (Gibson 1950). This third ranking is a

Where edges of dissimilar composition come together are lines and areas highly vulnerable to the impact of change in a landscape. Sky, water, land, and vegetation are the ingredients in the mosaic. Examples of meeting of diverse ingredients would be sky with land or forest, water with beach or riparian strip, ridgeline with distant surface, mineral face with brushland, and conifers with hardwoods. The visual relationship of one to the other runs the gamut in contrast--from high to low. The more conspicuous a meeting of ingredients, the more vulnerable it is to the impact of change. For edges I suggest the following ranking, from highest to lowest, of vulnerability:

(1) Skylines in any landscape, whether ordinary or special. They are the most sensitive because of the way they display changes. Two completely contrasting elements offer the strongest visual junction. The darker terrain solidity is in sharp contrast to the lighter film color of sky or the brightness of clouds.

(2) Edge and edge zone where land and water meet. Water has certain of the characteristics of sky--fluidity, life, and reflective brilliance. Normally, it is significantly lighter or darker than the adjacent vegetation or land surfaces (Litton *et al.* 1971).

"sometimes thing" because ridgelines may occasionally be skylines. Or they may be seen but poorly; the color-texture characteristics of the background foil can be close approximations of the ridge itself.

(4) Edges and mosaic areas which occur on the face of land. These kinds of faces consist of a variety of mineral or soil surfaces and vegetation types seen together. Their relationships suggest a broad range of contrast differences. An example would be the difference in visibility between light gray granite and dark green scrub oak; another would be sere grassland meeting a Douglas-fir forest.

(5) Junctions between dissimilar woody plants. An example would be an aspen grove surrounded by lodgepole pine. Other vegetation types compared can be visualized as having even more subtle relationships. And so this rank list could be carried down to levels approaching imperceptibility.

The edges and areas of plants and mineral which create a surface pattern have generally a much lower vulnerability than do these junctions which include sky or water. This effect is based on the potential for camouflage or absorption into the pattern if man-made alterations are designed with conformity to that pattern. Without conformity or other compatible relationships established in alterations, vulnerability becomes an open question. It must be recognized that the rankings I have proposed only represent tendencies of what to expect. Other factors may become dominant and exceptions must be expected.

Locations

There are several locations upon the face of the landscape where vulnerability varies. I refer particularly to elevational positions, some of which have also been suggested in the discussion of edges. Another hierarchy or ranking can be indicated to predict how obvious impacts can be (U.S. Forest Service Wyoming Study Team 1971). Higher locations are in general apt to be more apparent than lower ones.

A timber harvest is a well known kind of impact. And it is one of the most conspicuous as it involves skyline silhouettes and upper parts of ridges. Visual attention is directed to the maximum contrasts where sky and solids meet. Furthermore, the higher the location the greater its visibility from greater distances and from a more extensive area. And there is very little chance for effective screening.

A less conspicuous visual location will be that at the center of forested faces. In clearcutting as an example, contrasts between disturbed soil or grass and forbs against dark surrounding forest are the source of the display. And they can be strong indeed. Yet impacts of change in this mid-level location will not be seen from the full range of distances and broader areas that are true for higher positions.

The least conspicuous location--the area of least vulnerability--is low in the landscape, as for example, the bottom edge of forest land where it may often meet a dissimilar vegetation type. Changes in edge and perimeter enlargement are impacts not readily apparent as seen from low eye level or as viewed on a flat plane. It is here that details of impact can stand out as viewing distances tend to be short. But there is a high potential for screening by vegetation and terrain. It can also be expected that visibility is restricted to the smallest number of viewing points as a comparison is made with impacts in higher locations.

Again, while a hierarchy for vulnerability can be suggested for higher to lower locations of impacts, it must be recognized that exceptions will be found. Prediction of impact intensity will improve as we know better what the nature of the impact may be.

Outside Influences and Inherent Effects

Such ecosystem components as climate, microclimates, topography, and soils (Daubenmire 1968) can also be examined for ways they modify appearance of the landscape. They can also affect sensitivity or resistance to visual impacts. Generally, they are either regional in scope or applicable to any landscape. By "outside influences" I am referring to certain aspects of orientation, climate, and seasonal effects. And by "inherent effects," I mean differences of topographic slope, certain soil characteristics, and some kinds of vegetative covers. I recognize that it is not altogether possible to isolate the different components which come together to make the landscape. Yet it seems essential to try to separate them for the

sake of weighing factors and of establishing better understanding as to vulnerability sources.

Outside Influences

Controlling sunlight, insofar as it affects the broader landscape, is not within the manager's capability. But we can observe that different exposures influence contrasts in vegetative types. On the Pacific Coast, for example, a commercially important tree species may occur on a northerly face while the opposing southerly face can well be grassland. As a consequence, we could expect the impact of logging on one side but not the other--a difference in visual vulnerability. In an opposite vein, grassland would reveal road construction while timber could screen it.

Beyond differences of cover and surface with their contrasts in reflection or absorption of light, there are other differences in visibility related to orientation. For the northern hemisphere, surfaces exposed to the south will tend to be fully lit by the sun during most of the day. What happens there will be more conspicuous than in north side exposures, where backlighting and shadows will tend to shield and obscure. East and west orientations have a certain equality of visibility but at opposite times of the day. As morning light illuminates an east face, the west side will be in shadow--and the reverse for the afternoon. But a western exposure compared to eastern, suggests a more critical microclimate from afternoon heat intensity. For regeneration or replantation this could be interpreted as greater visual vulnerability than expected on an east side face or even the south. Thus light and shadow involved with orientation suggests a vulnerability ranking which is greatest for the south, followed in order by the west, east and the north. Climatic influences can, however, be expected to modify this ranking.

Different regional climates can, in oblique fashion, provide differences in visual sensitivity. Climates are directly linked to the nature of native cover and to vegetative recovery or regeneration after disturbance. The influence of New Mexico's aridity, California's Mediterranean climate, or Tennessee's humid climate suggests a scope of effects which can be expressed as vulnerabilities. After 30 years, the U.S. Army's tank tracks remain apparent on the military reservations in the California desert. Had Tennessee provided such a site, signs would have long since disappeared. Also related will be the ways in which storm patterns or intensities can be revealed in either erosional tendencies or deeper instabilities of certain soils.

Seasonal effects indicating changeable vulnerability can be as obvious as the wintertime openness of deciduous hardwood forests. Abandoned coal stripping banks in Appalachian hardwoods are never more apparent than in winter. By comparison, the evergreen forest is inherently stable, and screening is not a seasonal matter. In another effect, autumn foliage coloration may be especially significant in localized situations--temporarily producing feature landscapes. These will have their sphere of visual influence within which vulnerability to impact will be high. Similar observations may be made for areas where significant spring bloom occurs. Yet in the off-seasons, will these vulnerabilities be remembered?

Inherent Effects

Landforms and their particular range of topographic slopes are a primary means of defining different kinds of regional landscapes (Res. Plann. and Design Assoc. 1970). Within whatever landscape we care to consider, a crude axiom may be suggested: "The steeper the slope, the greater the potential for visual vulnerability." Several reasons support this--one is perceptual, another is impact scale and repair.

On flat and gentle sites, we observe with a nearly level line of sight. As a result, much is hidden by overlapping objects and perspective foreshortening. Screening is almost automatic. As we observe steeper and steeper slopes rising up in front of us, we see increasingly more of the slope surface and whatever it supports. Screening is not apt to be effective. Also, an activity such as road construction will occupy increasingly larger amounts of transverse area as slopes steepen. Thus, the scale of impact tends to grow and the scope and difficulty in reestablishing vegetation and soil stability also expand. Through suitable studies, critical ranges of slope and attendant levels of impact should be identifiable.

Soil color, particularly that of disturbed soil, is significant in the strength of visual landscape images. If exposed soils are dark, they are apt to be less apparent because they tend to match the usual

dark values of vegetation. The difficulty is that disturbed soils are usually lighter than undisturbed ones--a source of visual contrasts. The other complication is that wildlands soils, especially on steeper slopes, tend to be in the lighter color ranges of gray, yellow, or red. If it were possible to have the black loams of Illinois wherever an impact occurred, we could be less concerned with how soil disturbance relates to visual sensitivity. Beyond the simple fact of soil color is the matter of its inherent capacity to sustain plants. The light-colored soil which is hostile to plant growth carries vulnerability one step further.

Distinct patterns of vegetation and perhaps mineral exposures can absorb visual impacts if that existent mosaic is used as a guide to the design of alterations. But there is another aspect to this--what if the vegetative surface is essentially of uniform texture? Examples of this simplicity include the Douglas-fir forests of Oregon or those of lodgepole pine in Wyoming. They show but minor variations. Except for the minute visual (and physical) contrasts that result from stand variations, little guidance is offered that we may follow. Such simple textures explain in part--why the impact of clearcutting in these forests is so conspicuous, why visual vulnerability is high. To reduce such impacts, we need a more sophisticated design process, one based heavily upon the scale, the landform variations, and characteristics of the particular landscape involved.

Conclusions

The sources of visual vulnerability which I have identified are probably not new to you. What landscapes you have within your own purview can suggest more specific kinds and ranges of vulnerability. My thesis is this: before you consider the impact of any alterations, first look at the landscape as a resource in its own right and analyze its visual vulnerabilities. With this background of understanding, it should be much easier to arrange for designing alterations for proper fit to the landscape.

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DISPERSAL OF RECREATIONISTS ON WILDLANDS

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ABSTRACT.--A variety of automated reservation systems are now in use at or proposed for State and Federal campgrounds and parks. A research program to study problems associated with the dispersal of recreationists on wildlands is underway. It will evaluate and compare reservation and referral systems, evaluate operational systems, attempt to design a visitor dispersal system, and determine the applicability of dispersal systems to recreational uses other than camping.

INTRODUCTION

In all parts of the United States, visits to campgrounds, winter sport sites, wilderness areas, and other recreation sites continue to increase. As a consequence, many sites are overcrowded, subject to severe deterioration, and are becoming less conducive to quality recreational experiences. Resource managers are looking for ways to disperse visitors and even limit use in an effort to improve quality experiences and to protect sites from physical damage. Among the most common approaches either proposed or in use are reservation systems, referral systems, user fees, lottery systems, and outright user limits.

In a comprehensive study of reservation systems in use in the United States, Burnett (1972) found that only two of 23 systems were computerized and only the California State Park System was fully operational. To his list should be added the State of Virginia's computerized system. The Forest Service and National Park Service are planning to try out computerized systems in 1973. Most other systems are being used to administer group camping. Burnett (1972) found that reservation systems prove effective in reducing the impact of vandalism, maintenance costs, numbers of turnaways, site deterioration, and visitor conflicts associated with overcrowding. His study showed that use actually increased in California and Oregon Park Systems, but was distributed to more campgrounds in California. It also showed that entrance stations are needed for the successful operation of reservation systems.

Visitor acceptance of a reservation system is an important consideration to resource managers, but reports of public reaction are limited. Burnett reported a study by the Christian Science Monitor indicating that about 38 percent of the respondents suggested starting a reservation system for campgrounds. He also learned that resource managers had a "feeling" visitors were favorably disposed toward reservation systems, and that visitors at a national park in Colorado would favor such a system if it prevented overcrowding. But, Stong and Duke (1972) reported that 59 percent of the campers surveyed in the State of Washington did not prefer a reservation system for the State's parks. However, the respondents had little, if any, experience using a reservation system, which suggests the basis for comparing systems was weak. Nevertheless, dissatisfaction with a system's methods of operation may lead to public rejection. For example, Burnett found negative reactions by potential users because of the increased number of "no-shows" that cause sites to go vacant, the lack of vacancies after visitors had traveled long distances, and the lack of knowledge of a reservation system.

REFERRAL SYSTEMS IN USE

Variations of a referral system are currently in use at several locations. The State of Oregon operates a campground information center that serves as a reservation and referral center. People can call or drop in and find out what facilities are available and be directed to them. At Jackson Hole, Wyoming, a radio

station broadcasts campground status reports to incoming tourists to help the national forests and parks direct campers to areas with vacancies. Yellowstone National Park uses radio and roadside signs for the same purpose. Some radio stations, such as those in Denver and Los Angeles, broadcast information on camp vacancies.

User fees are being used or planned in conjunction with most reservation systems. Their purpose is not to control use, however, because that would discriminate against low income groups. Rather, fees are charged to assure that users pay a greater share of campground costs than do nonusers. Lotteries offer another means for controlling use. Sometimes they are used, for example, to disperse hunting tags for certain game species where hunting is essential to maintain a limited number of animals in balance with their environment. However, the use of lotteries to limit recreational use is considered to be administratively unwieldy and could possibly lead to ticket scalping (Sharpe 1973).

Burnett (1972) has suggested that manual reservation systems may become unwieldy as the number of requests becomes very large. The State of Oregon manually handled only 47,000 requests in 1971 (Oregon Parks and Recreation Sect. 1971), whereas the State of California's computerized system handled about 98,000 during the same year (Meyer 1973). Recognizing the problem, large agencies such as the Forest Service and the National Park Service are directing their pilot programs toward computerized systems. Several companies have reservation systems or the capabilities for developing them, and undoubtedly more will join the competition.

Coordination of services is an essential part of any reservation system if public agencies are to eliminate the chaos that many visitors now face when forced to move from one full campground to another on the basis of recommendations offered by poorly informed campground managers. This is not to criticize the managers, but to point out the great need for effective regional and interagency systems that can successfully disperse campers to areas where facilities are available or warn them of "all full" conditions before they leave home.

NATIONAL FORESTS

Even though a computerized reservation system has proved successful for making reservations for sports and entertainment attractions as well as for State park campgrounds, its usefulness to the national forests is not clearly defined. Individual State parks are usually closed systems with entrance gates and a resident staff. But national forest campgrounds are generally not designed and managed in such a manner. Entrance stations are practical at some campgrounds, but many others are not suited for such control. Therefore, it is desirable to investigate other means for dispersing use, compare them with the automated reservation system, and determine which system or combination of them may prove most useful on the national forests.

In addition, it may be valuable to develop a means for informing expected users that given areas are full, and redirect them to locations with vacancies. On key weekends, such as Labor Day, it would be desirable to warn people when areas are full and possibly encourage them to stay home. This suggests that a predictive model might be beneficial--a mathematical model that might tell, in advance, the approximate time when sites in key areas would be full. If such a model could be developed, it may then be possible to advise people not to leave home after a given time because all facilities would be at maximum capacity.

Historically, the Forest Service has told the public that the national forests are "theirs," as evident on highway signs and informational pieces that include such slogans as "Protect and Enjoy Your National Forest Heritage" or "The National Forests ...America's Playground." Some visitors may commence to doubt the "public" nature of the forests when they are faced with reservation requirements, user fees, and contact with commercial ticket vendors. Some may find the regimentation and mechanization objectionable. Others, on the other hand, will find the arrangements convenient and comforting in unfamiliar wildland situations. To some, a reservation system may seem unduly restrictive--even oppressive--especially those who like to roam and to be free of time schedules. Furthermore, a reservation

system may place some groups at a competitive disadvantage. People who cannot schedule their vacations well in advance may not be able to obtain a site when their vacation time is confirmed. Also, persons living in communities not served by a reservation system may be unaware of its existence or be less successful obtaining reservations by mail than persons who can make direct contact at a ticket office.

TRIAL OF A RESERVATION SYSTEM

Commencing with the 1973 camping season, the Inyo and San Bernardino National Forests in California plan to make about 990 units available on 20 campgrounds by selling tickets throughout the State. The system proposed is similar to that used at California State Parks. It was developed and is administered by Ticketron, a company which pioneered in computer-controlled ticketing for entertainment and sporting events.

Briefly, the system operates in the following manner (Ticketron, Inc. 1972). The user decides when and where he would like to go camping. He contacts the nearest Ticketron outlet (usually in major department stores in suburban shopping centers or downtown areas) either in person or by mail. He asks if space is available at the place and time of his choice and specifies his party size and kind of equipment. If space is available, a ticket is issued for a registration fee of $1.50 plus the daily campground fee for the number of days requested. Each ticket specifies the date and campground, but the camp unit is either indicated on the tickets or assigned upon arrival at the check station. Roving patrols are used to check tickets and direct campers where campground distribution and size make the use of check stations inefficient.

If a camper cannot obtain the camp of his choice, he is offered alternate days and size of units. Unfortunately, alternate campgrounds cannot be offered because a suitable computer program has not yet been designed to handle such cases. Ticketron is working on the problem, but until it is solved, campers must be prepared to suggest alternate campgrounds by using various campground directories.

A camper can cancel reservations and be refunded the campground fee. However, he forfeits the reservation fee, and in addition, pays an equivalent cancellation fee.

The period of advance reservation can be set according to agreement between Ticketron and the agency it is serving; e.g., 90 days for the State of California and 30 days for the Forest Service, at present. Ticket sales are stopped on Mondays for reservation periods commencing on the following Friday. Thus, the camper wishing to commence his stay on any Friday cannot make his reservation later than the previous Monday.

The Ticketron system provides nine reports that serve various accounting functions related to reservation status and sales. These reports allow agencies to control the reservation system and audit the entire operation.

The Ticketron system, as well as any other reservation or referral system, has shortcomings: (1) When campgrounds are filled to capacity, no statistics are provided concerning the number of parties turned away from ticket offices or campgrounds, the size of groups turned away, desired dates and lengths of stay, or facilities needed. (2) No information is provided concerning the subsequent action taken by turnaways; e.g., did they go camping? Where and when? (3) User or turnaway attitudes concerning the system are not sampled; e.g., do they feel too regimented? Do they like or dislike the system? etc.

Answers to such questions may suggest where new campgrounds are needed, which established campgrounds should be expanded, or explanations of why new development or expansion may not be possible. At a campground or recreation area controlled by entrance stations, the managers may not be concerned about turnaways since their numbers may rapidly diminish after users become aware that reservations are required. Such has been the case for the States of California (1971) and Virginia (Bolen 1973). However, campgrounds on the national forests are not all expected to be on the reservation system, and a large population of turnaways may continue to exist. Therefore, information concerning turnaways may prove useful for planning and administration.

RESEARCH ON VISITOR DISPERSAL

Forest recreation researchers at the Pacific Southwest Forest and Range Experiment Station are seeking information that could help solve some of the problems associated with improving visitor dispersal on wildlands. Studies underway are aimed at (1) evaluating the reservation system being tested at California region campgrounds, and (2) developing information useful for deciding which systems or combinations are best suited to the national forests. The objectives of the research, roughly in order of priority, are:

1. Evaluate and compare existing and proposed automated and manual reservation systems, referral systems, and combinations of both.

2. Evaluate visitor reaction to the automated reservation system being tested on two national forests in California by using unobtrusive techniques and mail questionnaires.

3. Design a visitor dispersal system to inform the public of site availability, limitations, or closures and to feed back information about potential use to field locations. (Such a system is planned to serve regional and interagency needs.)

4. Determine how to assess the success or failure of diverting use away from overused to less used sites, predicting when given sites will be full, and stopping the influx of visitors when sites are full.

5. Determine which registration/referral system alternatives or variations of alternatives will prove useful for controlling use on wilderness areas, winter sport sites, organizational camps, and other areas subject to intensive uses.

SYSTEM EVALUATION AND COMPARISON

Data will be collected for as many uniquely differing reservation and referral systems as can be identified. Each system will be analyzed individually and by making various combinations suited to agency capabilities and resource conditions. Factors to be considered may include, but not be limited to: a description of facilities, number and size of user parties, lengths of stay, kinds of equipment, visitor controls (area security and policing), turnaways, vandalism, fees (if any), personnel requirements, diversion of personnel from other jobs, public opinion, costs of operations (within limits of administrative cost accounting), visitor overflow (how much and how handled), and agency evaluations of systems.

Burnett (1972) found that eight States and one Federal agency operated reservation campgrounds using manually operated systems. Virginia has used an automated system; North Carolina and Pennsylvania are considering such systems (Bolen 1973). Information will be gathered to make comparisons between the manual and automated systems.

Reservation systems that are used by organizations such as hotel and motel chains, airlines, travel agencies, and commercial campground vendors will also be investigated. The logistics of such systems may differ from those required for campground reservation systems, but they would offer some useful ideas.

Referral systems are not so easily identified, but any that are functioning or proposed would be analyzed for their possible application.

EVALUATION OF VISITOR REACTION

The California region's goal is to provide "a higher level of public service" by assuring users the availability of a campsite upon arrival at their destination and thus improving the level of their recreational experience. The Region believes its goal may best be achieved through evaluation of user preferences and opinions. The use of unobtrusive techniques and mail questionnaires seems feasible for obtaining the necessary data.

Two unobtrusive methods will be used. First, letters sent by users, turnaways, and others offering comments, criticism, or plaudits will be collected and analyzed. Second, oral comments, criticisms, or commendations by users or turnaways or both volunteered to or overheard by attendants, rangers, and receptionists will be recorded and analyzed. In addition, mail questionnaires will be used to uncover visitors' opinions about the system, determine how they learned about the sys-

tem, find out why people canceled or failed to show without canceling, uncover opinions of the reservation system as compared to previous experiences at non-reservation camps, determine difficulties encountered while making reservations, define groups that the system may discriminate against, and determine what happens to visitors that are turned away.

The National Park Service is planning to start computerizing reservation systems at six national parks, including Yosemite. The Forest Service has been in touch with the Park Service, and it may be possible to include the Yosemite operation in the Station's study. If an organization other than Ticketron is selected to operate the park's system, it will be desirable to assess their differences to determine which offers the greater service to the public and the Federal Government. Even if Ticketron is selected by the Park Service, it may prove worthwhile to determine if differences exist between visitors of the parks and the forests. No fundamental changes in the research design are foreseen in the event Yosemite is included in the study.

VISITOR DISPERSAL AND FEEDBACK

Comparisons of reservation/referral systems are expected to suggest a continuum of the most desirable to the least desirable individual or combination of visitor dispersal systems. Pure referral and combinations of reservation and referral systems may require considerable design and coordination input to make them functional.

A visitor dispersal system could be organized around public information centers located in major population centers, such as Los Angeles or San Francisco. Campground status information would be sent from ranger district and forest supervisor's offices to these centers. These centers would provide users with the names of campgrounds or recreation areas that are full, areas where vacancies exist, estimates of when sites are expected to be full, and "Recreation Visitor Alerts" that warn of areas that have filled or are filling faster than originally estimated.

The centers could be used to solicit and coordinate radio, television, and newspaper coverage of recreational site conditions. And the media could direct reservation requests and questions to the centers.

Public information centers might be used to gather information from prospective users--particularly those that are referred to alternative sites, choose to defer their trip, or choose to cancel their plans altogether. Information to be gathered might include party size, desired date and length of stay, and kind of equipment. The data concerning potential site impact could then be sent to resource managers and used for decisionmaking and planning concerned with: expansion of existing facilities, construction of new facilities, limiting use where expansion or new development is not feasible, making estimates and requests for funding, recommending fee scales, reviewing special use permits to build commercial service facilities, designing new types of facilities, and developing public information programs to explain decisions.

Visitor dispersal and feedback systems should probably be automated since efficient visitor control may depend upon the speed with which information is transmitted from recreation areas to population centers. The study is expected to identify and assess means for quick, efficient, and economical transmission of information. Sources that may be considered, either individually or in combination, for designing the systems, include (a) existing national forest radio networks, (b) adaptations of the Ticketron system, (c) Campertron--electronic adaptation of radio and telephone nets (developed by Mike Levine, Inyo National Forest), (d) Federal Aviation Administration's air traffic control system, (e) other traffic control systems, and other reservation networks--hotels and motels, travel agencies, etc.

ASSESSMENT OF VISITOR DISPERSAL

The efficiency of any visitor dispersal system, be it a reservation or referral system, might be measured by the number of parties that can be diverted from one location to another, be persuaded to participate in an alternative recreational activity, or be persuaded to stay home. The study now underway will attempt to learn how to measure system efficiency, predict when sites are expected to be full, and stop user influx when maximum capacity is achieved.

We need to assess increases in visitation at underused sites as influenced by announcements at population centers that tell visitors where space is available. Simultaneously, it should be determined if such announcements tend to reduce the impact at overused sites. Point-of-origin data should also be collected to determine if people are coming from population centers where announcements were made, and control might be imposed by making announcements at specific urban areas but not at others. This is but one proposal; others will need to be developed and studied.

ADAPTATION TO OTHER LAND USES

The enormous growth in number of visitors to public lands is of concern to resource managers. Such intensive use is of particular concern in wilderness areas and at winter sport sites. Some form of user limitation or reservation system will likely be put into effect for wilderness use in the near future. Currently, users of wilderness areas in California are required to register before entering; they must specify the exact dates of use and locations to which they will travel. Managers at Sequoia-Kings Canyon National Park have been working with adjacent national forests and with Ticketron to determine the feasibility of a wilderness reservation system. Reservation systems are in use at many ski areas in the eastern United States, and within 10 years tickets may be needed to do any skiing in the West (Davis 1973).

The study will evaluate the possibility of adapting reservation/referral systems, developed for campgrounds, to the problem of limiting use on wilderness areas and other wildlands subject to excessive human impact.

CONCLUSIONS

Any reservation or dispersal system, with its attendant computerized mechanisms, ticketing, gatehouses, forms, and fees, inevitably brings urbanized life to the rural forest setting. People who leave the city to find a change in the wildlands are apt to discover that perhaps they experience less than they had anticipated. If the goal is to preserve wildland resources as places for enjoyment and changes from daily life styles, then the public must accept some trade offs to avoid creating areas that are only reflections of urban living. Any system designed to disperse visitors or limit their number should be considered but one of several tools to be studied and applied. Whatever system is adopted, its aim should be to prevent the exploitation of wildland resources and to regulate use at a level that will protect the resource base--and still maintain the quality of recreational experiences.

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MINORITY DEMAND FOR RESIDENT YOUTH CAMPING IN THE SOUTH

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ABSTRACT.--The recreation manager cannot afford to overlook minority preferences when he is estimating consumer demand. Minority demand is important in its own right, and it is important because of its impact upon demand of the majority. This paper describes black participation at resident youth camps in two Southern States, Alabama and Florida. Possible implications of increasing black participation are discussed.

DIFFERENT PATTERNS

Many public recreation facilities such as parks, playgrounds, and beaches in the United States were established largely to serve underprivileged minorities, and use of some of these facilities by minority groups is very high. Use of other public facilities, however, is markedly less among nonwhites than whites. For a variety of reasons, including traditions, facility locations, and average incomes, recreation patterns of whites and nonwhites differ. This statement is not a lament and is not meant to suggest that nonwhite patterns are inferior. They may be just as beneficial and enjoyable as those of whites. It should be recognized simply that minority and majority recreation patterns are not alike.

Drawing from the 1965 Survey of Outdoor Recreation Activities, Deskins (1973) found that walking, picnicking, driving for pleasure, playing outdoor games and sports, sightseeing, and swimming, among a long list of activities, were enjoyed by the highest percentage of nonwhites. Water skiing, camping, hunting, and hiking on trails with packs were the least popular. A similarity in the ranking of the outdoor activities by whites and nonwhites (rho = 0.93) suggests that the difference is of degree rather than kind. In a regional analysis he found that nonwhite equalled or exceeded white participation in bicycling, fishing, walking for pleasure, picnicking, and sightseeing. In a survey of municipal recreation in New York City, Kraus (1970) found that Negroes dominated such activities as track and field, use of public swimming facilities, basketball, and several forms of combative activity, especially boxing.

Suppliers of recreation recognize the rights of minorities to public facilities, but often wonder what types of services to supply. Today they are asking whether the new social climate of the United States will eliminate differences in recreation between whites and nonwhites, or whether the differences will persist.

Since my research in the last few years has centered on resident camping by minority youths, I will confine this paper to that area. The findings in this may, however, be applicable to other recreation situations.

MINORITY CAMPING

Camp Pleasant, the oldest known camp for blacks, was founded in 1906 near Washington, D.C. (Jones 1927). It was established 50 years after the Nation's first youth camp, but at a time when camping was just becoming popular for young people (Gibson 1968). The purpose of Camp Pleasant was to provide an environment for developing good health habits and participating in outdoor recreation. Camping, however, has developed mainly among middle and upper-lower-class blacks and whites. And almost all those that attend camps are from cities.

Recognizing important values of camping, the President in 1967, called for camping opportunities for 100,000 disadvantaged youth. This figure was about 1 percent of enrollment in American Camping Association (ACA) camps. The ACA responded by saying that its members had surpassed that figure and would double it in 2 years.

My 1970 survey of resident youth camps in Alabama and Florida suggested that the black participation had increased markedly in just a few years.

Prior to 1964, the year the Supreme Court abolished segregation laws on the use of public facilities, blacks seeking

resident camping in Alabama generally attended all-black camps. In 1970, Alabama had three such camps that served approximately 1,500 youths. The first of these was established in 1926 near Birmingham largely through the efforts of a black nurse. By 1970, the number of nonwhites attending intregrated camps was double the number attending the black camps. Almost one-half of the 71 camps in the State had at least one camper from a minority group. Nevertheless, the rate of camper participation remained low; only 7 percent of Alabama's 48,265 campers were nonwhite (Table 1). In face of new policies elsewhere, all-black camps are either closing or integrating.

Table 1.--*Reported and estimated camper numbers and participation rate in Florida and Alabama*

(In numbers)

Type of camper	Reported 1/	Estimated 2/	Participation rate/thousand
All campers:			
Florida	52,421	58,239	48
Alabama	48,265	48,265	68
Total	100,686	106,504	55
Black campers:			
Florida	8,137	8,884	35
Alabama	3,483	3,483	15
Total	11,620	12,367	26

1/ 151 camps.
2/ 162 camps.

The survey revealed only one all-black camp in Florida. It was established in 1952 by the Seventh Day Adventists and now accommodates over 240 youths. By 1970, the Scouts and other agencies had discontinued their separate camping operations for blacks and whites. A few religious and nearly all private camps had no minority attendance, but they represented less than one-fourth of the camps in the State. The estimated number of nonwhites in Florida resident camps was about 9,000 or almost three times that for Alabama. Moreover, the nonwhite camping rate of 35 per thousand persons of camping age was twice the rate of 15 for Alabama (Table 1). No doubt the more liberal interracial climate in Florida explains some of the differences.

EFFECT OF MINORITY DEMAND ON MAJORITY

Surveyors of recreation are interested in the impact of black upon white participation at specific locations. Kraus (1970) reported that whites abandoned public pools once attendance by Negroes reach a certain percentage. In the camps in Alabama and Florida, there was a weak but significant negative relationship between camp demand and black participation. Camps with the largest black participation were least likely to be full. An increase in black campers of 1 percent was associated with 0.2 percent decrease in total demand when seven other independent variables were held constant. There are several possible implications of this finding. Integration may have dampened overall attendance, or camps suffering demand deficits may have more readily accepted nonwhite campers.

The overall rate of camping for Florida youth of 48 per thousand was unexpectedly lower than the rate of 68 for Alabama. The discrepancy was greater when white campers only were compared. This low rate in Florida may have been caused to some extent by integration. Employee cutbacks in the space industry and other economic factors are believed to have entered the picture too. Stevenson in his study of ACA camps in the South found that a fear of an overall drop in demand was one of the main reasons cited by camp directors (mainly of private camps) for not admitting campers of all races.[1]

Resident youth camping among blacks appears to be increasing now that restrictions have been lowered. In other words, availability and accessibility have bred demand. The increase may indicate that ethnic differences in recreation patterns will not persist in a liberal climate.

But, paradoxically, increased activity by minorities may reduce majority participation. In some cases there may be a "tipping point," a certain percentage of minority participation that triggers a rejection of a facility by the majority. Not enough is known about this process in

[1] *Personal communication with John Stevenson of Clemson University who surveyed camps registered with the American Camping Association on their attitudes toward the ACA interfaith-interracial policy.*

recreation to justify speculation about particular percentages. Certainly models predicting demand for specific resources should consider the dampening effect of minority demand. At the same time that minority participation is encouraged, thought should be given to maintaining majority attendance.

Since the supply of outdoor recreation facilities is getting scarcer, denial of public facilities to certain groups is indefensible. The greatest number will receive the greatest good in the long run if participation by all groups is encouraged and intergroup harmony is actively promoted.

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INTERPRETATION TO INCREASE BENEFITS FOR RECREATIONISTS

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ABSTRACT.--To be effective, interpretation must attract and hold attention. For greatest interest, interpretation must be dynamic, rewarding to visitors, easily obtained, tailored to diverse visitors, and meaningfully structured. Evaluation of effectiveness requires feedback from visitors and objectives for which achievement can be measured.

By training, most resource managers are applied ecologists who have a wealth of special insights to share with people. This is important now that "ecology" is a household word. But, instead of being recognized as the good guys in the white hats, resource managers are increasingly thought of as villains. There are many reasons for this, one of which concerns our communication skills.

Before plunging into the how-to-do-it aspects of interpretation, we need to consider "What is interpretation?" and "Why should we bother ourselves with it?" Interpretation means the translation of information into understandable terms. In settings used by recreationists, interpretation refers to all the procedures used to make natural and cultural history understandable and enjoyable. Typical examples are campfire programs, guided walks, nature trails, exhibits, and visitor centers.

Why is this our concern? Why should we interpret the areas used by outdoor recreationists? To answer, we must examine our reasons for undertaking resource management of any kind.

No matter what the activity, we find that one overriding goal ties together all the diverse activities of resource management. This goal is to provide a sustained flow of benefits for people. Even private ownership and the search for profit are ultimately tied to a philosophy of promoting and sustaining the common good. We need to remember that wood, water, wildlife, recreation, and other land products are not ends in themselves but are means to the end of providing people with a sustained flow of benefits. Recreation experiences are "products" and thus benefits just as much as logs or other commodities.

This matter of benefits provides the first of four basic reasons for offering interpretation.

1. *By interpreting the areas we administer, we can directly enhance the experiences of our visitors and thereby increase the flow of benefits provided by such areas.* By enriching visitor experiences, interpretation can increase the production of benefits without an increased impact upon resources. The matter of benefits also provides a second reason for offering interpretation.

2. *Our continued tenure as land managers depends on our ability to provide people with many kinds of benefits.* Over the years, lands have continually been taken away from agencies concerned mostly with material products and have been transferred to agencies concerned primarily with experiences. If, on the basis of oversight or a utilitarian tradition, we ignore many values and default in making resources yield the full measure of benefits for which they are suited, then someone else may replace us.

3. *Interpretation can increase the effectiveness of resource management.* Informed visitors are likely to use resources with less damage than uninformed visitors. In addition, interpretation can be used to attract people to the areas suited for use and away from the areas that are overused or unsuited for heavy use.

4. *It is increasingly important to help people understand the dynamics of the natural environment and the consequences of their actions.* As all demands upon resources increase, the choices become more complex and difficult. At the same time, public participation in resource decisions is increasingly common, making an understanding of natural systems even more important for responsible citizenship.

Having considered what interpretation is and why it is important, we're ready to see what research can tell us about doing a better job. In the few studies addressed specifically to interpretation--and in the overwhelming amount of related research from such fields as education, communications, and psychology--three major points stand out. *The first is that any message must attract and hold the attention of the person for whom it is intended.* Otherwise, he will simply ignore it. *Second, we need clear objectives that define what we are trying to accomplish.* And *third, some means of feedback is essential to show how well objectives are being achieved.* Otherwise, we have no way of knowing the effectiveness of interpretation.

ATTRACTING ATTENTION

Unless we attract the visitor's attention, interpretation cannot be effective. An obvious first step in gaining attention is to provide interpretation where the visitors are. Yet this is not always done. Visitor centers, for example, are sometimes built out of view or even miles away from heavily traveled roads.

Sometimes interpretation is given where visitors will not stop or notice it. For example, at the Marine Science Center in Oregon, excellent exhibits are largely ignored because they are on walls *behind* visitors who are watching the live fish. To reach people, interpretation must be offered at such times and places and with such publicity that it is easy for them to use.

A number of introductory techniques are useful for gaining visitor attention (Boulanger and Smith 1973). One is to offer valuable knowledge or skills. For example, a presentation might begin with "What would you do if, while hiking, you met a bear with two cubs?" Or, it might begin with a discrepant or seemingly self-contradictory statement that arouses curiosity and requires explanation. For example, "This forest was created by a forest fire," or "The nearest formation of rock like this boulder is over 50 miles away." TV ads are full of discrepant events used for attracting attention.

HOLDING ATTENTION

To hold visitor attention, interpretation must be interesting. Interest depends on both the subject matter and the way it is presented. In a study of exhibits, we found higher visitor interest in violence and violent events than any other subject category (Washburne and Wagar 1972). This is nothing new. Plays and myths dating back thousands of years show that storytellers and entertainers have probably always known that violence is interesting. Fortunately, natural environments abound in violent stories that can be told in good taste.

Although such subject categories as violence, animals, and ecological relationships are predictably interesting, many visitors to interpretive programs are not seeking information, as such. Instead, they are often engaged in an open-minded search for new and enjoyable experiences. This often makes the pattern of presentation more important than the specific subject matter.

For greatest interest, interpretation must be dynamic, rewarding, and easy on the visitor. Other things equal, person-to-person interpretation is best and unmanned presentations need the same qualities. In our study of four visitor centers, we found visitor interest to be greatest for dynamic presentations that included such things as motion, recorded sound, and shifting lighting (Washburne and Wagar 1972). In contrast, interest was lowest for inert presentations involving mounted photos and written labels. Yet such "flatwork" exhibits are probably the commonest of all. The contrast between dynamic and inert is also very close to the contrast between the media used for entertainment (usually rewarding) and those used for education (often uncomfortable) (Washburne and Wagar 1972; Travers 1967).

The reward or payoff provided by interpretation is crucial for effectiveness. Too often, however, we become so concerned with the payoff to ourselves that we overlook the payoff for our visitors. As a result, we often concentrate on what we want people to know rather than why they would enjoy knowing it.

Rewards can take many forms. For the visitor who is already motivated to want information, such information is rewarding all by itself. Other visitors need a much larger "vehicle" of entertainment with a much smaller "load" of information. For example, at Disneyland, the Journey Through Inner Space was developed on behalf of a corporation at an enormous cost. Yet the visitor's experience of penetrating first a snowflake, then a molecular lattice, and even an atom within an ice crystal is almost

pure entertainment. Toward the end of the experience the visitor is told only the name of the corporation, the fact that it is in the business of rearranging molecules, and that he may see a few of the company's products on the way out if he chooses.

Psychologists have found that getting the right answer to a question is rewarding (Deterline 1962). This is the basis for teaching machines and programed instruction. As one application of this, we developed a programed nature trail in which visitors were asked a question at the bottom of each sign and then given the right answer on the next sign.[1] Children remembered more from these question-and-answer signs than from the usual signs.

One of the most rewarding things is simply having an effect when you do something. In one study, we built a recording quizboard on which visitors answer four questions by pushing buttons (Wagar 1972). Each time a correct button is pushed, a "correct answer" panel lights up and the visitor is presented with the next question. The quizboard--as the only exhibit in the building that could be manipulated--became a favorite exhibit for children the moment we installed it.

The rewards of interpretation may be appropriate ends in themselves. But if rewards are intended as means for increasing visitor understanding, then they must be carefully used so they help instead of hinder. For example, at the Chicago Museum of Science and Industry, most of the exhibits provide for visitor participation. But the day I visited, school groups were running about almost randomly twisting knobs, pushing buttons, and yanking handles but paying little attention to content. For best results we must make rewards contingent on learning or performing.

For interpretation to hold visitor attention, the rewards it offers must be worth the effort required from the visitor. This often requires making interpretation easy as well as rewarding for people. Making interpretation easy involves the use of symbols, tailoring presentations to the audience, and providing meaningful structure.

Messages are usually made of words, which are symbols. The words or other symbols used must be those the audience understands.[2] As an extreme case, a talk given in Chinese will not be understandable to most Americans. For greatest effectiveness, use words that fit the visitor's vocabulary. Also, use examples and analogies that draw upon things he has experienced. Often a few carefully chosen words can draw forth rich sensory memories that are shared by most members of your audience. How many of you, for example, remember specific places and occasions with the phrase "the sudden tug of a fish taking the bait"? If you draw upon the visitor's memory, his mind can supply thousands of times as much information as the words you used to trigger his thoughts.

Readability is important. In general, short sentences with little words are easier to understand than long sentences with big words. Formulas to determine levels of "readability" have been available for many years (Flesch 1949). However, Hunt and Brown found much of the interpretive material they sampled to be very difficult reading (Hunt and Brown 1971).

For people on vacation, reading may not seem worth the effort. At Yellowstone, for example, McDonald found that only about 10 percent of the visitors stopped at the wayside exhibits and less than half of them read the signs.[3]

Listening is easier than reading, and recorded sound has been associated with high visitor interest in several studies (Washburne and Wagar 1972; Mahaffey 1969; Erskine 1964).[1] For recorded sound, as with a real live interpreter, visitors can listen to information without looking away from main attractions. Also, substantial amounts of rather detailed information can be presented without visitor fatigue. If desirable, sound effects and dialog can be used to provide realism or drama.

In a study on a nature trail, we found cassette tape players to be extremely well received, especially when we kept the length down to 16 minutes for the 12 stations.[1]

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[1] *J. Alan Wagar. Evaluating interpretation and interpretive media. Paper presented April 7, 1972, to Assoc. of Interpretive Nat., Pine Mountain, Georgia. 14 p.*

[2] *Ronald E. Dick, David T. McKee, and J. Alan Wagar. A summary of major principles from communications and related fields. (Manuscript in preparation).*

[3] *Arthur L. McDonald. Final report to the National Park Service, Yellowstone Park. 35 p. 1969.*

For a 22-minute tape, a few visitors said the pace was too slow and that they would prefer a booklet permitting them to scan quickly to the information they wanted without waiting for it on tape.

Too often, interpretation is aimed at the nonexistent "average" visitor (Field and Wagar, in press). Tapes, for example, can be developed for different languages, interests, age or educational levels, or for visitors who want to spend different amounts of time. Additional groups to consider include families, local residents, and repeat visitors. Additional factors to consider in matching interpretation to different groups include levels of information and information needed before additional ideas can be understood (Boulanger and Smith 1973). For example, visitors cannot understand how a geyser works unless they already know that the boiling point of water changes with pressure.

A final factor to consider, if interpretation is to hold visitor attention, is structure. Visitors need some sort of framework to make information fit together meaningfully. In studying four visitor centers, we found that visitors were more interested in holistic than fragmented presentations. Thus exhibits that had parts making a whole story and that gave cause-and-effect relationships received greater visitor interest than exhibits that provided only isolated facts, such as the identification of species (Washburne and Wagar 1972).

As another example of structure, Screven, in his studies at the Milwaukee Public Museum (Screven 1969), found that visitors who were given a "pretest" to find out what they knew before seeing an exhibit remembered more from the exhibit than visitors who received no pretest.[4] Apparently the pretest gave them an outline of the things to look for. This suggests giving visitors an overview to orient them at the beginning of an interpretive presentation.

Orientation and focusing can also be provided within a presentation. One of our cassette tapes for a nature trail asked periodic questions of the visitor. This focused the visitor's attention and increased his retention of the information asked about. However, it *decreased* retention of information given just before and after a question.

At the Pacific Science Center, in Seattle, cartoon story lines are used to tie science stories together until youngsters learn enough concepts to handle a more scientific structure.[5] The cartoon stories serve another useful purpose. The person giving a demonstration often asks youngsters what would happen if the cartoon character took a given action. If a youngster gives a wrong answer, it's the cartoon character's problem, not his own. This "projective" technique saves the child's ego enough that he'll go right on volunteering answers without embarrassment.

Other methods of giving structure to a presentation include proceeding from the simple to complex, proceeding from the whole to the parts, presenting a chronological development, progressing from the familiar to unfamiliar, moving from the seen to unseen, and showing increasingly broad application of a principle (Boulanger and Smith 1973).

OBJECTIVES

Although the various techniques for gaining and holding visitor attention are vital for effective interpretation, they do not specify what it is we're trying to accomplish. For this, we need objectives.

A problem with objectives for interpretation has been to make them specific enough to provide a basis for evaluating and improving effectiveness. Usually they are stated as broad goals; for example, "Interpret the natural and scenic attractions of Horsethief Valley," or "Enrich the visitor's experience during his visit to Badger Flats." Although such broad goals serve as useful policy statements, they provide no yardsticks against which to measure achievement. How do you know when the attractions of Horsethief Valley have been effectively interpreted?

We can solve part of the problem by borrowing the idea of behavioral objectives from the educators (Mager 1962). Behavioral objectives specify what a student, or visitor, should be able to do as a result of a presentation. An example would be, "After hearing the nature talk at Horsethief Valley, the visitor should be able to name and describe the three major forces that shaped the valley." Such objectives provide a basis for measuring effectiveness.

To gain the advantages of broad policy goals as well as very specific behavioral objectives, we can develop a pyramid or

[4] *C. G. Screven. Personal communication, 1970.*

[5] *Jerry Dotson. Personal communication, 1970.*

hierarchy of objectives (Putney and Wagar 1973). In this, each broad policy goal must be supported by one or more layers of specific objectives which, if achieved, contribute toward accomplishment of that policy goal. For example, a broad policy goal might be "Show visitors the positive and negative effects of environmental modification."

One of several more specific objectives that are consistent with this goal might be "Show visitors the interrelatedness of the parts of an ecosystem." Such an objective is specific enough to provide a basis for selecting among the interpretive opportunities available.

If, within the planning area, a salmon stream is judged to provide the most suitable opportunity for showing the interrelatedness of ecosystem parts, then a number of very specific behavioral objectives can be developed to specify what visitors should be able to do on the basis of the interpretation. Such objectives might include, "Enable visitors to describe the life cycle of the Pacific salmon, conditions necessary for survival of the eggs and young fish, and human activities that can upset these conditions."

FEEDBACK

As soon as interpreters are thinking in terms of very specific objectives, then feedback and evaluation can be built right into interpretive programs--something that has seldom been done. A great deal of feedback is available informally, as interpreters watch their audiences, listen to questions asked, and look for other evidence of interest, enjoyment, puzzlement, and so on. In fact, such continuous feedback is a major advantage of person-to-person presentations. However, informal feedback can be misleading. Because many visitors are polite enough to compliment an interpreter for a bad program, any bad habits he may have are reinforced. Informal feedback therefore needs to be supplemented with more formal methods.

One approach is to use interviews or questionnaires to determine how well visitors are enjoying and remembering. A second approach is to provide games or self-testing devices such as the recording quizboard (Wagar 1972). These record numbers of right and wrong answers and provide a basis for evaluating changes in a presentation. Currently we are working toward observational techniques for determining audience interest and interactive audiovisual presentations that ask questions and record answers as well as tell a story.

An additional phase of feedback and evaluation is to determine cost per visitor contact or perhaps some other unit of visitor participation.[6] This requires records for both costs and attendance. In a study of visitor contact facilities in the Black Hills National Forest, we found a wide range of costs per contact. We also found that nobody knew the cost per contact for various alternatives. Yet without this kind of information, cost-effectiveness cannot be defined.

In summary, interpretation offers a way of increasing the benefits provided by our natural resources. For greatest effectiveness in interpretation, we need to make it rewarding for people; we need clear objectives; and we need feedback and evaluation to tell us how well objectives are being achieved.

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[6] *Allen D. Putney and J. Alan Wagar. Cost per visitor contact: a step toward cost-effectiveness in interpretive methods. (Manuscript in preparation).*

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MARKET RESEARCH--THE MISSING LINK IN RESOURCE-DEVELOPMENT PLANNING FOR OUTDOOR RECREATION

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ABSTRACT.--The development of progressive models of outdoor recreation markets is described, with emphasis on research findings from the family camping market. An introductory stages-of-growth model is presented in stages: infancy, adolescence, young adulthood, and maturity. From this, a more complete model of camping market expansion is developed, which details the sizes of and relationships among various segments of the camping market, potential, active, and inactive. A final comprehensive model ties together the concepts of market expansion and market development. Implications for management, research, and recreation resource planning are described for each stage of market growth.

THE "CHAOS OF CONFUSION"

Grodzins (1962) described outdoor recreation as a "chaos of confusion" as he viewed the multiplicity of agencies, missions, and jurisdictions that have a finger in the outdoor recreation pie. He concluded that the virtues of chaos, such as interagency competition, are far more desirable than the hazards of orderliness and the immense power that accompanies it. Significantly, Grodzins' impressions of chaos date from his 1962 examination of Federal agency involvement in outdoor recreation before the days of a Bureau of Outdoor Recreation, all-terrain recreational vehicles, environmental impact statements, snowmobiles, over 4 million camping vehicles on the road, standing-room-only wildernesses, $25,000 motor homes, and a commercial sector of recreation developments that dwarfs the combined involvement of all levels of government.

In listing the merits of a confused and chaotic state, Grodzins completely missed one of its greatest virtues: scientific appeal. There is a strong and fundamental scientific appeal to ordering disordered states. My objective is to try to chart an orderly path through the maze of industry propaganda and emotional pronouncements about the opportunities and threats of growing outdoor recreation markets.

My basic premises are: (1) that most outdoor recreation activities can be studied usefully in the context of a market; that is, buyers and sellers conducting marketplace transactions in an environment of close substitutes, (2) that most decisions by consumers of outdoor recreation goods and services take place in relatively typical market situations. For example, the selection of a campground after arriving at a regional tourist attraction, the purchase of a seasonal skiing pass, and even the mail-order selection of a wilderness visit among competing sets of wilderness trail ride offers, (3) that market research, which is essentially a kit of tools for reducing risk in management decisions, has some potential for improving the state of public and private outdoor recreation planning, and (4) that risk in management decisions can be related to dollars in order to determine how much to invest in research for any given market situation.

The subject matter of market research can be classified broadly into two reasonably distinct areas:

Marketing research includes informal "in-store" experiments along with comparisons of the effectiveness of different types, exposures, and content of advertising appeals; also more formal studies of consumer preferences, buying habits, and the testing of various marketing theories such as brand loyalty and impulse buying.

Market structure research focuses on such phenomena as trends in the size and geographic distribution of firms in a market, product differentiation, shifting market shares, and industry growth rates.

Ideally, these two types of research should complement each other. In outdoor recreation research they do not. We have produced an abundance of consumer studies, but have developed no logical market framework to tie them to. Recently, in examin-

ing camper surveys to develop an annotated bibliography, I found that there are hundreds of studies about campers, but that hard data about campground numbers, occupancy rates, and the general state of the campground industry are nearly impossible to find.

The fact that we have hundreds of consumer surveys and no generalized market model by which to interpret them is probably related to many of the embarrassing situations that outdoor recreation management and research finds itself in today. For example, we seem to know quite a bit about skiers, but we know so little about the state of the skier market that we have moratoriums on further ski area development in some of our prime skiing country in the Northeast. We apparently know a great deal about campers, but we know so little about the camping market that at least one campground trade association would like to see legislation enacted requiring the filing of an "economic impact statement" before development of new campground facilities on public lands. And, of course, for all our consumer research of the past 10 years, we can still do no better job of forecasting recreation demands than we did in the early 1960's.

A STAGES-OF-GROWTH MODEL

The growth of a market over time follows the pattern of a generalized growth curve just as the growth of a population does, or the growth of any biological organism. So the analogy of human growth stages to the growth of a recreation industry is very appropriate (Peterson 1971). Figure 1 depicts a generalized growth curve and identifies segments of that curve as five broad stages of growth: infancy, adolescence, young adulthood, maturity, and senility.

There are many ways that a generalized model such as Figure 1 can be useful without any further refinement of the growth stages. For example, it is possible to study available industry growth rates and to arbitrarily place many recreation markets within different stages on the curve. Hunting, its growth approximately equal to the rate of population expansion, could be termed a mature recreation market; all-terrain recreation vehicles, with growth rates of 5 to 10 times that of the population, represent an adolescent market. An adolescent market is one that is highly responsive to mass advertising appeals.

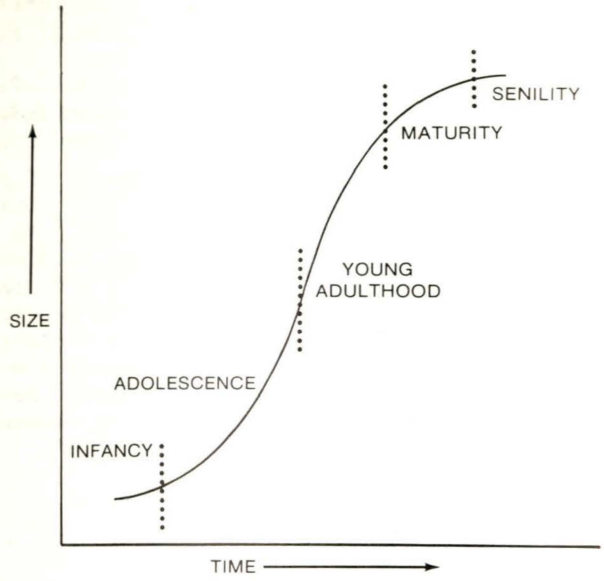

Figure 1.--A general model of a recreation market growth curve, with arbitrary placement of five broad stages of market growth. Measures of "size" along the Y axis can be in any specified terms, dollars invested, units of production, numbers of enterprises, capacity, or numbers of campers, skiers, visitor-days, etc.

Clearly, if indices of growth--population expansion and per-capita increases in travel, income, and leisure--are drawn from a mature economy and used to derive coefficients of expansion for recreation markets that are in stages of adolescence and young adulthood, demand predictions will fall far short of their true potential. And, of course, this is exactly what has happened to most of our attempts to predict recreation demand.

The utility of a stages-of-growth model can be enhanced much further if accepted definitions of each growth stage are available, making it possible to be less arbitrary in locating the relative positions of various outdoor recreation markets. To this end, the following provisional descriptions of the first four stages are offered. No attempt is made to describe the fifth stage (senility); its occurrence will be rare because of the immense marketing and technological investments that mature recreation industries will expend in order to recycle the market into a more vigorous growth stage.

Stage 1--Infancy

This is a period of extreme inefficiency in such areas as buying power, merchandising, and communications. This growth stage is characterized by a large number of entrepreneurs, all having a good idea at about the same time. They recognize an apparent demand for something like commercially developed campsites because they may be in a position to see an increasing incidence of capacity crowds at public parks. But they have little capital to develop an enterprise. And, because the industry is new, their available sources of borrowing are limited. There is little variety and diversity in the types of developments and services offered to the public. Management and marketing are largely matters of trial and error because of a lack of experience and lack of knowledge of the market.

Infancy, at least in commercial recreation developments, is also a period when the majority of enterprises are located on land already owned by the developer. In many instances, the owner may have been looking for some type of development that would help him to pay the taxes and retain ownership. Individual enterprises have relatively little awareness of each other and practically no communication with each other. There is little public concern about the industry in terms of a need to control, license, register, or set standards. Research is almost nonexistent.

Stage 2--Adolescence

Exact boundaries between growth stages are meaningless. But at some point, an industry begins to develop very rapid growth in number of enterprises. The growth of recreational vehicle manufacturers and the growth of commercial campgrounds followed parallel patterns. In this stage, enterprises have larger capacities and bigger financial investments. The average investment per enterprise in stage 2 may be 5 or 10 times that of stage 1. Individual enterprises begin to become more business oriented; they are more concerned with early returns rather than with building a retirement nest egg. Campgrounds during stage 2 began to have full-time managers. Sources of venture capital open up as risks begin to become well established. This is the period of experimentation with new forms of management: associations, affiliations, and franchises. Developments in stage 2 are often on land that was purchased because of its ideal market location. Trade associations emerge, strengthen, and begin to become involved in such things as communications, standard setting, and collective buying.

Coincident with the growing importance of communication within the industry, research becomes a dominant value and takes the form of feasibility studies, economic analyses, and preliminary attempts to identify trends in growth. Established corporations, looking for opportunities to diversify, conduct some market studies on their own and establish a few pilot projects, or experimental developments.

Stage 3--Young Adulthood

This is a preliminary shakedown period for the industry. Many of the stage 1 Ma-and-Pa type enterprises can no longer compete in the market and disappear from view. In short, there is a gradual shifting in market shares toward the larger and more efficient operations. There is a noticeable shift in the size distribution of firms in the market. The period of phenomenal growth may be over, but a sustained period of impressive growth rates may remain.

During stage 3, the value of market information becomes well established. Many enterprises begin to contract their own research or even set up their own research branches. At the same time that information is becoming an important satellite industry, many established information sources begin to dry up as industry leaders are increasingly reluctant to share the knowledge that may give them a competitive edge.

Toward the middle of stage 3, a shift in trade association activities toward lobbying may become evident. This is not simply a response to the growing level of industry secrecy, but may also reflect a direct response to increasing public concern for needed legislation and social control of a potentially powerful industry.

Stage 4--Maturity

Growth, in terms of new enterprises, drops to the level of or below the rate of population expansion. Expansion of existing enterprises may continue as a favored form of competition. The market becomes dominated by a smaller number of large concerns and trade associations. Growth of individual enterprises takes place at the expense of other enterprises. Broad industry-wide promotions are more frequently aimed at increasing the spending of people who are already in the market as opposed to

earlier efforts to expand the size of the market.

In stage 4, research becomes "intelligence," and most enterprises now buy their own and guard it closely. The research focus is on ways to delay further market maturity through technology, equipment innovations, improved marketing appeals, and second guessing the competition. Broadly sponsored market studies, and those conducted by public agencies, take the form of statistical reporting.

Trade associations in a mature market, except in times of a threat of outside interference, may take on an almost symbolic country club role, providing sources of enhanced prestige for industry leaders.

A TEST OF THE MODEL: THE CAMPING MARKET

Research plays a markedly different role in each of the growth stages. In theory, we could determine the relative growth stage of a market by the type of research attention that it is receiving. However, a comprehensive examination of the total research effort is rarely possible because of poor communication systems in the industry's early stages and secrecy in the later stages.

A consistent role of research throughout the growth process is to monitor market growth in order to identify the stage, and even substage, that the market is currently in. This type of knowledge has obvious implications for the timing and location of new developments, for determining appropriate marketing strategy and for effectively predicting short-term demands.

Even with complete agreement on the growth stage descriptions, it is practically impossible to locate the camping market more precisely than somewhere between late stage 2 and early stage 4. Additional information is needed. And it is usually available from a variety of sources. Existing consumer studies may provide some clues to current market stage; historical analyses of the growth rates of the market's component industries can provide further clues; and the generation of new information may be required if the need is great enough. Some very brief examples of each type of research, drawn from a recent examination of the camping market, may be useful.

Analysis of Available Camper Surveys

The large number of available camper surveys, dating from the late 1950's, provides a rich (though often frustrating) source of information about possible trends in camping. For example, it is often possible to make gross comparisons between the findings of recent camper surveys and older studies of items such as: (1) the percentage of campers who have just begun to camp, (2) the relative proportions of tenters and vehicle users, (3) the average level of annual camping participation, and (4) investments in camping equipment.

From such an analysis we might conclude that numbers of campers and their equipment investments are increasing, but that average levels of camping participation may be decreasing. Such a finding could indicate that the market is still in a relatively young growth stage and that it is adding new participants faster than the available supply of campsites can accommodate them. The result is that something has to give, namely the number of days of camping per year. Such an observation might even be reinforced by a historical examination of campers' comments in regard to "crowding," "difficulty in finding available campsites," and "the increasing need for reserving a campsite before leaving home."

Growth Rates of Component Industries

Although this may be the weakest, and often most biased, source of market data, published information is generally available about growth trends in the several component and service industries of a recreation market. For example, it is not particularly difficult to obtain information about the number of companies publishing campground guidebooks and camping magazines (both public and trade journals) and their circulation figures. Production figures for recreational vehicles are available on an annual basis. The number (now over 50) and size of campground franchising organizations is probably an important indicator of market growth; so is the number and membership of campground trade associations. And the number of commercial campgrounds, and their capacities, can be dug out of licensing bureau records and from past censuses and surveys in some States.

A recent examination of the commercial camping market in New Hampshire (LaPage *et al.* 1972) disclosed that the number of camping enterprises in that State doubled every 3 years from 1955 to 1964. The next doubling did not occur for 8 years, until 1972. A similar slowdown in the production statistics issued by the Recreation Vehicle Insti-

tute is evident. Both trends reflect a normal pattern of growth that would be expected from our knowledge of the growth curve. But they do serve to suggest that the camping market is out of the phenomenal growth period of stage 2 and well into stage 3.

Generation of Original Information

At this point, the need for new information may become critical to many investors in the market. If, in fact, our analysis is correct and the camping market is well into stage 3, this means that a distinct slowdown in growth (stage 4) may not be too far away. Many industry leaders would now like to know how much room for market expansion is left?

However, that question cannot be answered by any source of available data because all research up to this point has concentrated upon the growth of the active camping market and not upon the concurrent shrinkage of the potential camping market. (The physical law of equal and opposite reactions works on markets too!) In an attempt to answer this question, the Forest Service, in cooperation with several industry leaders, recently conducted a national survey of the camping market's potential for future expansion.

This national survey (LaPage 1973), in addition to providing some estimates of growth potential, also served as a means of validating the apparent trends that are evident in several regional and local camper surveys. And, although these smaller surveys are seldom strictly comparable in methodology, dates, and market segment focus, we found that the national survey confirmed such observations as a decline in average camping rates, shifts in camping styles, and an increase in complaints about campground conditions, notably crowding.

EXPANDING THE MODEL

As research generates new information and is able to integrate it successfully with the information that has been lying on the shelf collecting dust, another important role of the market analyst emerges--that of model builder. Starting with a very simple but useful growth-curve model, it is now possible to expand that model into a comprehensive model of the entire camping market system. The advantages of a system model over the simple stages of a growth model come from being able to understand how all of the various market segments are interrelated and influence each other.

The first step in graduating the growth model into a system model comes with the realization that, as the active camping market expands, its reservoir for future growth (the potential camping market) shrinks. In simplest terms, this can be viewed as the area above the growth curve being compressed as the area below that curve expands. However, a more useful and realistic model is presented in Figure 2, in which prospective campers move through various stages of potential from a low to a high propensity to try camping. Similarly, after those with a high potential become campers, they move through a series of stages toward permanent camping inactivity to complete the cycle.

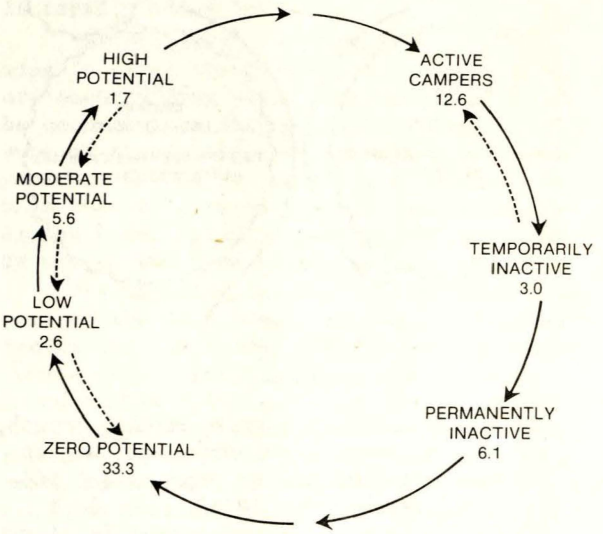

Figure 2.--A model of camping market expansion, showing the approximate sizes of various market segments (in millions of households). Based on a 1971 national survey of 2,003 households, conducted by Opinion Research Corp. Note the possibility of flow reversals (dotted lines) among certain segments of the potential and developed camping markets.

Through the results of our national camper market survey (LaPage 1973), we have been able to place figures on each of these steps in the cycle in terms of millions of households. And through continued research, we will be able to estimate rates of flow between the various segments of this system and also learn how those rates may be affected by mass advertising and other marketing appeals.

The recognition that there is a dynamic cycle of involvement in the camping market

leads to two added, and critically important, components of that cycle (Fig. 3). The first of these components is a *drive* or *control mechanism* which can speed up or slow down the rate of movement through the cycle. This control mechanism, itself a complicated system, is labeled simply "advertising." In fact, it is all of the varieties of mass persuasion, social pressures, and market promotions that are used to encourage new sales.

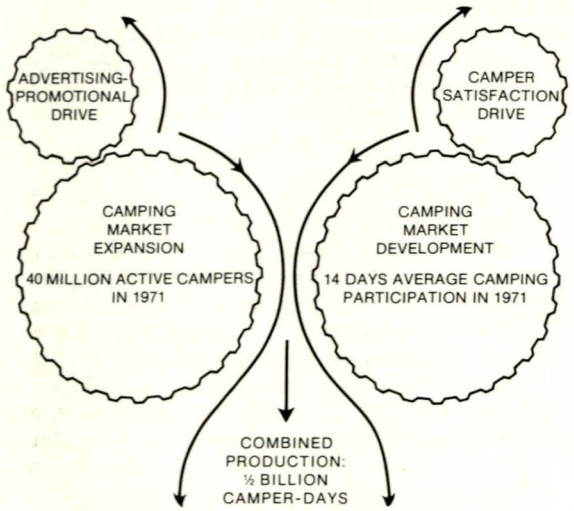
ADVERTISING-PROMOTIONAL DRIVE
CAMPER SATISFACTION DRIVE
CAMPING MARKET EXPANSION
40 MILLION ACTIVE CAMPERS IN 1971
CAMPING MARKET DEVELOPMENT
14 DAYS AVERAGE CAMPING PARTICIPATION IN 1971
COMBINED PRODUCTION: ½ BILLION CAMPER-DAYS

Figure 3.--A model of camping market growth, showing how market expansion and market development combined to produce 1/2 billion camper-days (in 1971). The left side of this model is presented in greater detail in Figure 1.

The second essential component--to complete the market model--is based on the concept of an *efficient rate* at which this cycle of market expansion should operate. That is, the camping market should not be expanded, through the efforts of its control mechanism, at a rate that cannot be matched by the ability of its component industries to provide thoroughly satisfying camping experiences. For example, if the number and diverse interests of new campers who are encouraged to enter the market exceeds the number, quality, variety, and geographic distribution, of available campsites, the camping cycle will speed up, campers will be dissatisfied, and many will become inactive after a year or two instead of staying in the camping market for a much longer period of time.

If the camping market expands much faster than facilities are developed, several results can be predicted. First, with rising dissatisfaction, campers will begin to camp less, the average rate of camping participation will decline, and that decline may offset whatever gains are achieved through market expansion and costly promotions. In addition to declining participation rates and increasing market dropout rates, camper dissatisfaction may be expressed in other ways such as purchasing land for a personal campsite, or otherwise changing camping styles. Campers may continue camping just as much, but in avoiding the crowds and waiting lines at public campsites they also eliminate much of their former economic impact.

Since all these effects seem too evident today--a rapidly expanding inactive segment of the camping market and a steady decline in camping frequencies--we can conclude that the two halves of the camping market, expansion and development, are not operating efficiently.

IMPLICATIONS FOR MANAGEMENT

Any improvement in understanding recreation markets, their growth curves, and their market systems, will present opportunities for alert administrators--through better timing of their development planning, through more appropriate marketing strategies, and through the correction of sources of consumer dissatisfaction. However, the really significant implication of the research and model building that I have described lies in demonstrating the need for comprehensive market development planning.

The camping market is not unique among outdoor recreation markets in its fragmentation of the forces that influence market expansion and development. The rate of market expansion is controlled largely by the hundreds of equipment manufacturers and their individual and collective mass persuasion tactics. And the rate of market development through building more and better campsites is controlled by scores of public agencies and thousands of private developers (Hunt 1969).

In an ideally operating market system, expansion of demand should stimulate expansion of supply after a reasonable time lag. However, fragmented recreation market systems are far from ideal. Public agency development plans are highly subject to broad policy considerations and budget restraints that are totally unrelated to market situations. Private development planning--and even most corporate development planning--is totally uncoordinated and increasingly secretive.

The one segment of the system that offers a reasonable opportunity to introduce comprehensive development planning is the public sector at the Federal level. The luxury of planning in a vacuum may have been appropriate to the make-work projects of the 1930's, when recreation was a pawn of other national policies; but it is hardly appropriate to today's outdoor recreation market situations. Public recreation agency planning for the development of new recreation areas and the expansion of existing facilities must be tied to a total understanding of recreation market systems, the capabilities of the private sector, and industry's plans for expansion.

In addition to its role as a direct provider of recreation opportunities, the public sector also acts as a catalyst and stimulant to private investment. Campgrounds can be built where they are needed through public-private cooperation, and much more efficiently than they can through the competitive expansion of facilities on remote public holdings or by acquiring more public land and reducing the tax base in areas where private enterprise could operate profitably.

Historically, the public sector's role has been to move into a recreation market during its infancy in an attempt to set standards, stimulate economies, and respond to an apparent need that private enterprise cannot yet fill. Unfortunately, the public sector has rarely found it easy to move out as the market matures and use its resources to provide leadership in new directions. In failing to move out, it runs the certain risk of losing its former leadership role, becoming noncompetitive, lowering standards, and even depressing local economies because of lower-than-average price structures and higher-than-average wage rates.

Our camper market studies tell us that camping participation is declining. But they do not tell us how much of that decline is due to: (1) the direct effect of an inadequate supply of campsites; (2) the indirect effect of camper dissatisfaction due to lack of quality, variety, and appropriate geographic distribution of facilities; (3) a normal social trend resulting from increased camper involvement in other activities that compete for his free time; and (4) an artifact of the data resulting from the fact that camping trips took more time in years past because of less mobile equipment, poorer highways, and a poorer geographic distribution of developed campgrounds.

CONCLUSION

In summary, just as the market research role changes with each new growth stage of a recreation market, so too does the role of outdoor recreation planners, developers, managers, and promoters. Historically, the public sector's role has been to move into a recreation market during its infancy in an attempt to stimulate the rural economy and set standards. Unfortunately, the public sector has not found it so easy to move out as the market matures.

The mass of research evidence, along with our unbiased understanding of the workings of growth curves, indicates that the camping market is well into growth stage 3 and that its potential for future expansion is rapidly being dried up.

The potential camping market is like a mine in which the yield is of a lower grade ore each passing year. Eventually, it may be necessary to abandon the mine and rework some of the tailings of past years; to expand the market by improving conditions in ways that will reattract the camping market dropouts and stimulate more camping activity by people who have already tried camping.

The maturing camping market is just one part of the even more complex and fragmented recreation industrial complex, which has become a major contributor to the economy. Based on the estimated size of that economic contribution and the proven value of market research in other less complex fields, our token investment in recreation market studies provides powerful proof that Grodzins' 1962 "Chaos of Confusion" doesn't begin to describe the situation in 1973!

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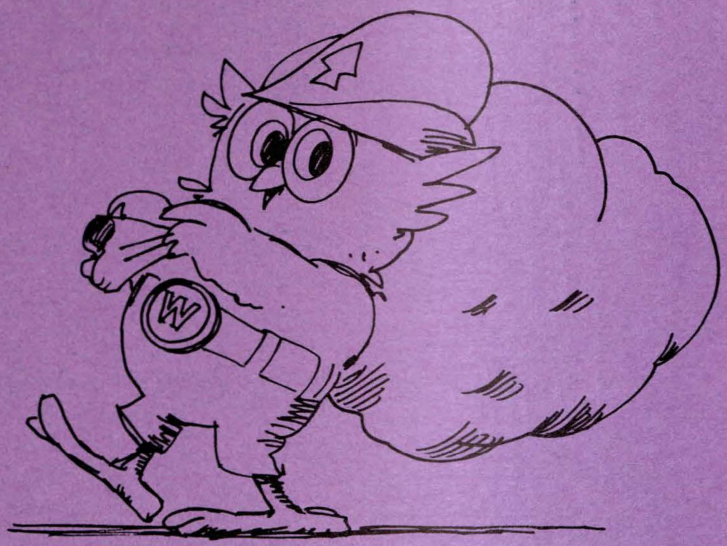

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